

Not Reported in F.Supp.2d, 2009 WL 1575169 (E.D.Cal.), 70 ERC 1168  
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public health or safety,” “[t]he degree to which the effects on the quality of the human environment are likely to be highly controversial,” “[t]he degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks,” and “[w]hether the action is related to other actions with individually insignificant but cumulatively significant impacts.”

*Id.* at 1185–86 (citing [40 C.F.R. § 1508.27\(b\)\(2\)](#), (4), (5), (7)). If an agency does not prepare an EIS, the reviewing court must “determine whether the responsible agency has ‘reasonably concluded’ that the project will have no significant adverse environmental consequences.” [Upper Snake River Ch. of Trout Unlimited v. Hodel](#), 921 F.2d 232, 234 (9th Cir.1990).

\*13 12. Plaintiffs principally rely on two cases to support their assertion that an EIS was required here: [Westlands v. United States](#), 850 F.Supp. 1388 (E.D.Cal.1994) and [Ramsey v. Kantor](#), 96 F.3d 434 (9th Cir.1996). The *Westlands* decision denied federal defendants’ motion to dismiss water districts’ claims that NMFS and the Bureau failed to comply with NEPA by, among other things, not completing an EA or EIS before issuing a biological opinion concerning the effects of coordinated operations on the winter-run Chinook Salmon and implementing the reasonable and prudent alternative articulated in that biological opinion. *Id.* at 1394–95. Federal defendants in *Westlands* argued that the biological opinion was not a “major federal action” because it was merely advisory. *Id.* at 1420 (citing [40 C.F.R. § 1508.18\(b\)](#) (3)). The district court acknowledged authority in support of this argument, but ultimately concluded that a case-by-case inquiry is required:

Formal plans and official documents that guide or prescribe alternative uses, on which future agency action will be based, are “federal actions” for NEPA purposes. *See* 40 C.F.R. § 1508(b) (2).

Plaintiffs argue that a biological opinion that suggests reasonable and prudent alternatives falls within either definition, because an agency must either follow the alternative suggested or risk violation of ESA § 7(a)(2)....

\* \* \*

A biological opinion is part of the ESA process originated by [16 U.S.C. § 1536\(a\)\(2\)](#), which requires federal agencies, with the assistance of the Secretary, to “insure that any action authorized, funded, or carried out by such agency ... is not likely to jeopardize the continued existence of any endangered species or threatened species.” The federal agency undertaking such activity must consult the service having jurisdiction over the relevant endangered species. [16 U.S.C. § 1536\(a\)\(3\)](#). The U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS), are jointly responsible for administering the ESA. [50 C.F.R. § 402.01\(b\)](#) (1992). The consulting service then issues a biological opinion that details how the proposed action “affects the species or its critical habitat,” including the impact of incidental takings of the species. [16 U.S.C. § 1536\(b\)\(3\)\(A\)](#).

“The agency is not required to adopt the alternatives suggested in the biological opinion; however, if the Secretary deviates from them, he does so subject to the risk that he has not satisfied the standard of Section 7(a)(2).” [Tribal Village of Akutan v. Hodel](#), 869 F.2d 1185, 1193 (9th Cir.1988) (citation omitted), cert. denied, 493 U.S. 873, 110 S.Ct. 204, 107 L.Ed.2d 157 (1989). A Secretary can depart from the suggestions in a biological opinion, and so long as he or she takes “alternative, reasonably adequate steps to insure the continued existence of any endangered or threatened species,” no ESA violation occurs. *Id.* at 1193–95; [Pyramid Lake Paiute Tribe of Indians v. Department of Navy](#), 898 F.2d 1410, 1418 (9th Cir.1990) (“a non-Interior agency is given discretion to decide whether to implement conservation recommendations put forth by the FWS”). The Joint Regulations state:

\*14 The Service may provide with the biological opinion a statement containing discretionary conservation recommendations. Conservation recommendations are advisory and are not intended to carry any binding legal force.

[50 C.F.R. § 402.14\(j\)](#) (1992). [50 C.F.R. § 402.15\(a\)](#) states:

(a) Following the issuance of a biological opinion, the Federal agency shall determine whether and in what manner to proceed with the action in

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light of its section 7 obligations and the Service's biological opinion.

Courts have attempted to define the “point of commitment,” at which the filing of an EIS is required, during the planning process of a federal project. See *Sierra Club v. Peterson*, 717 F.2d 1409, 1414 (D.C.Cir.1983). “An EIS must be prepared before any irreversible and irretrievable commitment of resources.” *Comner v. Burford*, 848 F.2d 1441, 1446 (9th Cir.1988), cert. denied 489 U.S. 1012, 109 S.Ct. 1121, 103 L.Ed.2d 184 (1989). 40 C.F.R. § 1502.5(a) similarly provides, “For projects directly undertaken by Federal agencies, the environmental impact statement shall be prepared at the feasibility analysis (go/no go) stage and may be supplemented at a later stage if necessary.”

[One of the water agency plaintiffs] points out that the Environmental Review Procedures, under the National Oceanic and Atmospheric Administration (“NOAA”) Order No. 216–6, § 6.02.c.2(d), require an EIS for:

Federal plans, studies, or reports prepared by NOAA that could determine the nature of future major actions to be undertaken by NOAA or other federal agencies that would significantly affect the quality of the human environment.

It is undisputed that the NMFS's actions are subject to an EIS requirement, if those actions are a “major federal action significantly affecting the human environment.” Under 40 C.F.R. § 1508.18(b)(2), an activity is a federal action if it “guides,” rather than binds, the use of federal resources. CVP water is a federal resource. *The Bureau's options were narrow had it declined to follow the NMFS's reasonable and prudent alternatives.* See *Tribal Village of Akutan*, 869 F.2d at 1193 (agency need not adopt reasonable and prudent alternatives in biological opinion, so long as it complied with ESA Section 7(a)(2) by taking “alternative, reasonably adequate steps to insure the continued existence of any endangered or threatened species”); *Portland Audubon Society v. Endangered Species*, 984 F.2d 1534, 1537 (9th Cir.1993) (discusses exemptions from ESA, by application to the Committee under 16 U.S.C. §§ 1536(a)(2), (g)(1)–(2)).

The government submits *Bennett v. Plenert*, CV–93–6076, 1993 WL 669429 (D.Or.1993), as authority that biological opinions are not binding on federal agencies, and consequently are not major federal actions. But in *Bennett*, the court left open the issue that a biological opinion could constitute a major federal action under NEPA. *Id.* at p. 11, n. 4. *Biological opinions are not binding on the Secretary, nor do they invariably require an EIS. The inquiry requires a case by case analysis.*

\*15 *Id.* at 1420–22 (emphasis added) (parallel citations omitted). Applying the required case-by-case approach, because “the biological opinion is part of a systematic and connected set of agency decisions which result in the commitment of substantial federal resources for a statutory program, which resulted in reallocation of over 225,000 acre feet of CVP water under the ESA for salmon protection with the environmental impacts alleged,” the biological opinion was major federal action.

13. Here, Federal Defendants argue that if anything constitutes a major federal action, it is the *Bureau's* implementation of the OMR flow restrictions, not FWS's adoption of the 2008 BiOp itself. Doc. 56 at 20. Federal Defendants argue that FWS's issuance of the BiOp “by itself, is not an irretrievable commitment of resources,” and therefore does not trigger NEPA. *Id.* at 17. In theory, the Bureau had the option to reject FWS's RPA, albeit at its own peril under the ESA. However, in reality, the Bureau is implementing the projects in accordance with the RPA under an adaptive management structure that places ultimate control over OMR flows in the FWS. Although the facts of *Westlands* do not exactly parallel the circumstances here, there is a strong likelihood that Plaintiffs will be able to establish that NEPA was triggered by the issuance of the final biological opinion in this case.<sup>FN7</sup>

FN7. Environmental Intervenors also correctly point out that the Ninth Circuit reversed the district court's ruling on a related issue; i.e., federal defendants' contention that an irreconcilable conflict between the CVPIA and NEPA existed. *Westlands Water Dist. v. NRDC*, 43 F.3d 457, 460 (9th Cir.1994). The Ninth Circuit found that CVPIA §§ 3406(b)(2) and (d)(1) required implementation of the CVPIA “upon enact-

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ment.” *Id.* After this ruling, Plaintiffs voluntarily dismissed their claim that NMFS and the Bureau failed to conduct a NEPA review of the biological opinion concerning CVP impacts on winter-run Chinook salmon. See [Stockton East Water Dist. v. United States](#), 75 Fed. Cl. 321, 326 (2007). This does not derogate *Westlands*’ substantive NEPA analysis.

14. Federal Defendants argue this case is more like [Upper Snake River](#), 921 F.2d at 234, in which the Ninth Circuit “reaffirmed a long-standing principle that a federal action is not ‘major’ for NEPA purposes where the agency activity does not change the status quo and was inferentially part of routine management action in the operation of the dam.” *Westlands*, 850 F.Supp. 1415 (citing *Upper Snake River*, 912 F.2d at 234). *Westlands* specifically distinguished *Upper Snake River*, determining that whether or not an EIS was required “will, of necessity, depend heavily upon the unique factual circumstances of each case.” *Id.* (citing [Westside Property Owners v. Schlesinger](#), 597 F.2d 1214, 1224 (9th Cir.1979)).

To some extent, the finding is based on whether the proposed agency action and its environmental effects were within the contemplation of the original project when adopted or approved. See [ [Port of Astoria, Or. v. Hodel](#), 595 F.2d 467, 476 (9th Cir.1979) ]; [Robinswood Community Club \[v. Volpe\]](#), 506 F.2d 1366 [ (9th Cir.1974) ]. The inquiry requires a determination of whether plaintiffs have complained of actions which may cause significant degradation of the human environment. [ *City and County of San Francisco v. United States*, 615 F.2, 498, 500 (9th Cir.1980) ].

[Westlands](#), 850 F.Supp. at 1415. “[T]he taking of water for non-agricultural purposes is alleged to have changed the operational requirements of the CVP, imposed new standards for reverse flows in the Western Delta, carryover storage in the Shasta reservoir, and caused closure of the Delta cross-channel. Such actions and the environmental effects alleged are not routine managerial changes.” *Id.* at 1421.

\*16 15. Federal Defendants maintain that, like in *Upper Snake River* and unlike in *Westlands*, “Reclamation’s continued management of the CVP—even after issuance of the Service’s biological opinion—is

within historical operating parameters.” Doc. 56 at 18. *Upper Snake River*, specifically concerned the Bureau’s decision to reduce flows below Palisades Dam and Reservoir. Although it was standard operating procedure since 1956 to maintain flows below that dam above 1,000 cfs, during previous dry periods, the average flow had “been lower than 1,000 cfs for 555 days (or 4.75% of the total days in operation).” *Id.* at 233. Because the challenged flow fluctuations were within historical operational patterns, no NEPA compliance was required:

The Federal defendants in this case had been operating the dam for upwards of ten years before the effective date of the Act. During that period, they have from time to time and depending on the river’s flow level, adjusted up or down the volume of water released from the Dam. *What they did in prior years and what they were doing during the period under consideration were no more than the routine managerial actions regularly carried on from the outset without change.* They are simply operating the facility in the manner intended. In short, they are doing nothing new, nor more extensive, nor other than that contemplated when the project was first operational. Its operation is and has been carried on and the consequences have been no different than those in years past.

The plaintiffs point out that flow rates have been significantly below 1,000 cfs for periods of seven days or more only in water years 1977, 1982, and 1988, all years of major drought. They also note that prior to construction of the dam, the lowest recorded flow rate did not fall below 1400 cfs. From these facts, they argue that the Bureau’s reduction of the flow below 1,000 cfs is not a routine managerial action. However, a particular flow rate will vary over time as changing weather conditions dictate. In particular, low flows are the routine during drought years. What does not change is the Bureau’s monitoring and control of the flow rate to ensure that the most practicable conservation of water is achieved in the Minidoka Irrigation Project. Such activity by the Bureau is routine.

*Id.* at 235–36 (emphasis added).

16. Here, unlike in *Upper Snake River*, the OMR restrictions imposed by the 2008 BiOp are *not* “routine managerial actions regularly carried on from the

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outset [of the Project] without change.” It is undisputed that the OMR flow restrictions of Component 2 have the potential to impose restrictions on the CVP’s ability to export water south of the Delta above and beyond that which would result from natural conditions and pre-existing legal regimes. *See generally* Doc. 46, Snow Decl; Doc. 56–3, Milligan Decl. As was the case in *Westlands*, “the taking of water for non-agricultural purposes is alleged to have changed the operational requirements of the CVP [and] imposed new standards for reverse flows in the Western Delta....” [850 F.Supp. at 1421](#). Evidence shows that operation at –1250 cfs during the relevant time period will result in a net reduction of water service to Plaintiffs exceeding 200,000 acre feet (“AF”). There is substantial likelihood that Plaintiffs will be able to establish that these changes substantially depart from the type of routine managerial changes that took place prior to the 2008 BiOp.

\*17 17. Plaintiffs also rely on *Ramsey*, which held that NMFS was required to comply with NEPA when it issued a biological opinion and incidental take statement under ESA § 7, permitting state regulators to issue salmon fishing regulations consistent with the take statement. [96 F.3d at 441–445](#). *Ramsey* found the biological opinion and incidental take statement constituted “major federal action,” triggering NEPA compliance, as it was “clear ... both from our cases and from the federal regulations, *see* [40 C.F.R. § 1508.18](#), that if a federal permit is a prerequisite for a project with adverse impact on the environment, issuance of that permit does constitute major federal action and the federal agency involved must conduct an EA and possibly an EIS before granting it.” *Id.* at 444.

18. *Ramsey* then determined:

the incidental take statement in this case is functionally equivalent to a permit because the activity in question would, for all practical purposes, be prohibited but for the incidental take statement. Accordingly, we hold that the issuance of that statement constitutes major federal action for purposes of NEPA.

*Id.*

19. Federal Defendants suggest *Ramsey* has no direct bearing on this case, because, unlike Washing-

ton and Oregon, here, the Bureau does not require a section 10 permit to operate the CVP in compliance with the BiOp:

Instead, as in the instant case, Section 7 of the ESA provides a procedure whereby federal agencies may obtain an exception to the ESA’s ‘take’ prohibition through the issuance of a biological opinion and incidental take statement; unlike the Section 10 context, if NEPA applies at all in the context of Section 7, it applies when the action agency takes some action.... There is no suggestion in *Ramsey* that NEPA would apply in the instant case, where the take statement authorized merely the activities of federal agencies, and in no way acts like a Section 10 permit for private parties. The highly unusual circumstances in *Ramsey* render that holding inapplicable to the case at bar.

Doc. 56 at 18–19.

20. The federal defendants in *Ramsey* argued that there was insufficient federal participation in a state run project to require an EIS. The Appeals Court disagreed: “if a federal permit is a prerequisite for a project with adverse impact on the environment, issuance of that permit does constitute a major federal action....” triggering NEPA. [96 F.3d at 444](#) (citing *Jones v. Gordon*, [792 F.2d 821, 827–29 \(9th Cir.1986\)](#); *Port of Astoria v. Hodel*, [595 F.2d 467, 478–79 \(9th Cir.1979\)](#)). *Ramsey* held that “the incidental take statement in this case is functionally equivalent to a permit because the activity in question would, for all practical purposes, be prohibited but for the incidental take statement.” *Id.* Because the incidental take statement was the functional equivalent of a permit, NEPA applied to the issuance of the biological opinion under *Jones* and *Port of Astoria*, despite federal defendants’ contention that the mere issuance of an incidental take statement was insufficient federal participation in a state project. Here, in contrast, the CVP is an entirely federal project, rendering the “functional equivalency” analysis from *Ramsey* largely irrelevant. In a more general sense, *Ramsey* simply stands for the proposition that it may be appropriate to apply NEPA to the issuance of a biological opinion under certain circumstances.

\*18 21. More directly applicable is [40 C.F.R. § 1508.18\(4\)](#), which provides that major federal actions include:

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*Approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities.*

The BiOp, and specifically Component 2 of the RPA, are management activities located in a defined geographic area that were approved by a regulatory decision.

22. Environmental Intervenors and Federal Defendants cite a number of cases for the proposition that *Ramsey* should be limited to its facts. For example, in *Southwest Center for Biological Diversity v. Klasse*, 1999 WL 34689321 (E.D.Cal. Apr.1, 1999), the court considered whether FWS failed to comply with NEPA when it issued a BiOp and incidental take statement after consultation with the Army Corps of Engineers (“Corps”) regarding its operation of a dam on the Kern River. The court rejected this argument, finding that plaintiffs’ claim was based on an “overbroad interpretation” of *Ramsey*, which “did not intend to require the FWS to file NEPA documents every time it issues an incidental take statement to a federal agency.” 1999 WL 34689321 at \*11. See also *P’ship for a Sustainable Future v. U.S. Fish & Wildlife Serv.*, 2002 WL 33883548 at \*7 (M.D.Fla. July 12, 2002) (“As a cooperating agency, the FWS is not required to duplicate the work of the Corps by preparing its own EA or EIS”); *City of Santa Clarita v. FWS*, 2006 WL 4743970 at \*19 (C.D.Cal. Jan.20, 2006) (finding that ITSs issued by FWS “were not ‘major federal action’ triggering separate and additional NEPA obligations on the part of the Service”); *Miccosukee Tribe of Indians of Fla. v. U.S.*, 430 F.Supp.2d 1328, 1335 (S.D.Fla.2006) (“To expect or require FWS to submit its own EIS, in spite of the fact that it was not the action agency and that the Corps had already issued one is nonsensical and an utter waste of government resources”). <sup>FN8</sup>

<sup>FN8</sup>. Plaintiffs point to Federal Rule of Appellate Procedure 32.1 and Ninth Circuit Rule 36-3, which prohibit citation to unpublished appellate decisions issued prior to January 1, 2007. However, these rules do not address citation to unpublished district court opinions, which are, like published district court opinions, only persuasive au-

thority. See *Carmichael Lodge No. 2103, Benevolent and Protective Order of Elks of the United States of Am. v. Leonard*, 2009 WL 1118896 (E.D.Cal., Apr.23, 2009) (noting that “there is no prohibition in citing ‘unpublished’ district court opinions (unless a local rule so provides. They are either persuasive to the case at bar, or they are not. District court opinions, published or not, do not set binding precedent for other cases....”) (irony of citing unpublished district court opinion as authority for citing unpublished district court opinion noted).

23. These cases are not persuasive. In three of the four cases cited, *City of Santa Clarita, Partnership for a Sustainable Future*, and *Miccosukee Tribe*, the action agency either had already or was in the process of completing environmental analysis under NEPA. The fourth case, *Klasse*, concerned challenge to the Army Corps of Engineers’ modification of operations at Isabella Reservoir. *Klasse* found that the Corps’ modifications, like those at issue in *Upper Snake River*, did not “deviate[ ] from [the Corps’] standard management scheme regarding water levels.” 1999 WL 34689321 at \*11. <sup>FN9</sup>

<sup>FN9</sup>. Similarly, federal Defendants cite *Greater Yellowstone Coal v. Flowers*, 359 F.3d 1257, 1276 (10th Cir.2004), for the proposition that *Ramsey* should be limited to its facts. But *Greater Yellowstone* simply cites *Ramsey*’s holding, without limiting its reach or scope. Moreover, the issue in *Greater Yellowstone* was whether the action agency should have prepared an EIS rather than a FONSI, not whether FWS had any NEPA obligations relative to its issuance of a BiOp. Likewise, *Center for Biological Diversity v. Fish and Wildlife Service*, 2005 WL 2000928 (N.D.Cal. Aug.19, 2005) (“*CBD*”), involved a challenge to a rule issued pursuant to section 4(d) of the ESA, which requires the Secretary to “issue such regulations as he deems necessary and advisable to provide for the conservation of [a] threatened species.” 16 U.S.C. § 1533(d). *CBD* summarily dismissed the possibility that a section 4(d) regulation could be subject to NEPA because applying NEPA would “confuse matters by overlaying its

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own independent matrix” on top of the ESA’s statutorily defined factors for determining that a species should be listed as threatened. [2005 WL 2000928 at \\*12](#). There is no parallel set of statutory factors with which NEPA could conflict in this case. Finally, Federal Defendants cite, [Westlands Water District v. United States Department of the Interior](#), 275 F.Supp.2d 1157, 1221 (E.D.Cal.2002), which involved a no-jeopardy opinion, in which the court cited *Keasee* with approval for the proposition that “FWS is not required to file NEPA documents every time it issues a biological opinion or an incidental take statement.” *Id.* at 1221–22. Nevertheless, Reclamation and FWS did release an Environmental Impact Statement/Report, *id.* at 1171, and the Court ultimately ordered “Interior” to complete a supplemental EIS. *Id.* at 1235.

24. In the final analysis, while the issuance of an incidental take statement does not necessarily require the preparation of an EIS, [Westlands Water Dist. v. United States Dep’t of the Interior](#), 275 F.Supp.2d 1157, 1221 (E.D.Cal.2002) (“FWS is not required to file NEPA documents every time it issues a biological opinion or an incidental take statement.”), *rev’d*, *aff’d*, *remanded* on other grounds, 376 F.3d 853 (9th Cir.2004), factual circumstances may give rise to NEPA obligations in connection with the issuance of a BiOp/ITS, *see* [Westlands](#), 850 F.Supp. at 1422; [Ramsey](#), 96 F.3d at 441–445.

\*19 25. FWS’s RPA is major federal action that has unquestioned ability to inflict great harm to Plaintiffs and the human environment. The federal action is prescribed by FWS and implemented by Reclamation. These agencies’ actions are inextricably intertwined. There is a strong likelihood that Plaintiffs will be able to establish that OMR flow restrictions imposed by the 2008 BiOp will have substantial, detrimental, indirect effects on the Plaintiffs, the community, and the human environment. Because FWS ultimately controls OMR flows, there is a strong likelihood that Plaintiffs will prevail on the merits of their NEPA claim under the specific facts of this case.

b. *Federal Defendants’ Reliance on Metropolitan Edison is Misplaced.*

26. Federal Defendants argue that “as a matter of law, NEPA does not impose requirements for an action that does not, by itself, alter the physical environment,” citing *Metropolitan Edison Co. v. People Against Nuclear Energy*, 460 U.S. 766, 772 (1983). The language from *Metropolitan Edison* to which Federal Defendants refer addressed whether NEPA requires agencies to consider effects on human health, specifically psychological health, as part of the “physical environment.” *Id.* at 771. The Supreme Court rejected this argument:

To paraphrase the statutory language in light of the facts of this case, where an agency action significantly affects the quality of the human environment, the agency must evaluate the “environmental impact” and any unavoidable adverse environmental effects of its proposal. The theme of § 102 is sounded by the adjective “environmental”: NEPA does not require the agency to assess every impact or effect of its proposed action, but only the impact or effect on the environment. If we were to seize the word “environmental” out of its context and give it the broadest possible definition, the words “adverse environmental effects” might embrace virtually any consequence of a governmental action that some one thought “adverse.” But we think the context of the statute shows that Congress was talking about the physical environment—the world around us, so to speak. NEPA was designed to promote human welfare by alerting governmental actors to the effect of their proposed actions on the physical environment.

*Id.* at 772.

27. Whether the OMR flow restrictions set forth in the BiOp significantly affect the physical environment is a question of fact on which *Metropolitan Edison* sheds no light. Plaintiffs have submitted undisputed evidence that shows the OMR restrictions may have significant effects on the physical environment, including land fallowing and increased groundwater use, as well as adverse effects on the water table, soil quality, and air quality.

c. *Wrong Lead Agency Argument.*

28. Environmental intervenors argue that Plaintiffs’ NEPA claim must fail because FWS, the only named defendant in that claim, is not the appropriate “lead agency” for NEPA purposes.<sup>FN10</sup> Where more

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than one federal agency is involved in an action, the agencies are required to coordinate their efforts and determine a “lead agency” responsible for NEPA compliance. [40 C.F.R. § 1501.5\(c\)](#); *see id.* § 1508.16 (defining “Lead agency”). Other agencies involved are designated as “cooperating agencies.” *Id.* § 1501.6; *see id.* § 1508.5 (defining “Cooperating agency”). The lead agency is required to use any environmental analysis from cooperating agencies, which may have jurisdiction by law or expertise in particular areas, in preparing its NEPA documents. § 1501.6.

**FN10.** In a related argument Environmental Intervenor attempt to further distinguish *Ramsey* based on the fact that, in that case, NMFS both issued and was one of the recipients of the incidental take statement. In this way, the Ninth Circuit noted in a footnote that *Ramsey* was “factually ... unusual.” [96 F.3d at 441](#) n .11. But, the Ninth Circuit did not assign this unusual factual circumstance any particular weight, other than to note that no party suggested that the agency suffered from a conflict of interest. *Id.*

**\*20 29.** Applicable regulations allow agencies to share NEPA responsibility if more than one agency is involved in the same action or a group of related actions. *See Sierra Club v. U.S. Army Corps of Eng'rs*, [295 F.3d 1209, 1215 \(11th Cir.2002\)](#); [40 C.F.R. § 1501.5](#). Environmental Intervenor correctly point out that, in this case, the Bureau has been designated the “lead Federal agency,” at least for the purposes of ESA consultation, concerning coordinated CVP–SWP operations. BiOp at i. The Bureau also prepared the BA regarding impacts of CVP operations on the delta smelt, which is a step often taken as part of an agency's NEPA compliance. *See* [16 U.S.C. § 1536\(c\)\(1\)](#) (BA “may be undertaken as part of a Federal agency's compliance with the requirements of [NEPA] section 102”).

30. However, FWS nevertheless proceeded as the sole issuing agency of the BiOp, which contains the RPA and incidental take statement, and proscribed the implementation of the adaptive management process, which constitutes and will involve regulated agency actions, in the absence of NEPA compliance. An agency may not justify, post hoc, its failure to comply with NEPA on the basis that some other agency prepared an environmental assessment

in the past or may prepare one in the future. *See Anacostia Watershed Soc'y v. Babbitt*, [871 F.Supp. 475, 485–486 \(D.D.C.1994\)](#).

d. *Is Any Requirement to Comply with NEPA Obviated by the Court–Imposed Time Constraints.*

31. Environmental Intervenor argue that “[e]ven if the BO could be considered a major federal action, this Court's previous orders setting a fixed time period for FWS to issue the opinion precluded NEPA compliance.” Doc. 58 at 19. The 2004 BiOp was remanded on December 14, 2007, with instructions to complete a new BiOp on or before September 15, 2008. *NRDC* Doc. 560 at 2. On July 29, 2008, the Federal Defendants informed the Court that “the Service no longer believed that it would be possible to complete a scientifically sound and legally defensible biological opinion by September 15, 2008, and moved to extend the deadline to December 15, 2008.” *See* Doc. 753, Findings of Fact, Conclusions of Law, and Order Granting Federal Defendants' Motion for Extension of Time, at 1–2. DWR joined in that motion. *Id.* at 2. No other party opposed the extension to provide the agency a full year to complete the new BiOp. *Id.* The district court granted Federal Defendants' request for additional time based on Federal Defendants submission that:

The consultation between the Bureau of Reclamation (“Reclamation”) and the Service on the OCAP will be one of the most complex “in the history of the [Endangered Species Act (‘ESA’)].” *See* Declaration of Cay Collette Goude, Docket No. 712–2 (July 29, 2008), ¶ 6. Reclamation's “biological assessment” (“BA”) of the effects of these operations itself totals more than 1,000 pages. *Id.* The Service is required by the ESA to review all of the “best scientific and commercial data available,” [16 U.S.C. § 1536\(a\)\(2\)](#), in preparing this biological opinion, and the statute and its regulations allow the Service 135 days to complete a biological opinion (from the submission and review of the BA). *See* [16 U.S.C. § 1536\(b\)\(1\)](#); [50 C.F.R. § 402.14\(e\)](#) (allowing 90 days for formal consultation and then 45 additional days to write the biological opinion). For these reasons, holding the Service to the current deadline of September 15, 2008 could result in a biological opinion that was not scientifically sound or legally defensible, and thus result in another cycle of remand, interim remedies, and judicial review that would ultimately delay the completion of

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an adequate biological opinion and tax the resources of the Court, the agencies, and the parties.

**\*21** *Id.*

32. Environmental Intervenor argue that the expedited timeframe for issuance of a new BO precluded compliance with NEPA. Even recognizing authority in support of this proposition, *see* H. Conf. Rep., No. 765, 91st Cong., 1st Sess. (1969), reprinted in 1969 U.S.C.C.A.N. 2767, 2770 (indicating that NEPA applies unless “the existing law applicable to such agency’s operations expressly prohibits or makes full compliance with one of the directives impossible”); *Westlands*, 850 F.Supp.2d. at 1416–17 (acknowledging the possibility that an evidentiary showing by Federal Defendants could establish that NEPA compliance is impossible), Federal Defendants have expressly declined to invoke this exception here, after direct inquiry in open court at the hearing on this motion. This exception does not apply. Draft Hearing Transcript, May 22, 2009, at 68–69.

*e. Consequences of Failing to Comply with NEPA.*

If a full EIS would have been required for the BiOp, FWS and/or the Bureau would have had to evaluate the cumulative and indirect impacts of, and consider a reasonable range of alternatives to the RPA. *See Ctr. for Biological Diversity*, 538 F.3d at 1185. NEPA does not dictate the outcome of agency deliberations; “instead, NEPA is aimed at ensuring agencies make informed decisions and contemplate the environmental impacts of their actions.” *Ocean Mammal Inst.*, 546 F.Supp.2d at 971 (citing *Idaho Sporting Cong.*, 137 F.3d at 1149).

*3. ESA Claims against FWS.*

33. The Complaint and motion for preliminary injunction also raise claims under the ESA. Because there is likelihood of success on the NEPA claims, it is unnecessary to evaluate the merit of the ESA claims at this time.

*4. The Requested Injunction.*

34. Plaintiffs request a limited injunction to prohibit FWS, and those acting in concert or participation with FWS, including the Bureau, from setting or implementing the OMR flow restrictions under BiOp RPA Component 2 unless and until FWS further explains why alternative, less restrictive OMR flows

would not adequately protect the delta smelt. <sup>FN11</sup>

<sup>FN11</sup>. Environmental Intervenor note that both the delta smelt and longfin smelt are state-listed species under CESA. *See* 14Cal. Code Regs. § 670.5; Obegi Decl. at ¶ 8 & Attch. 7. The SWG, which includes DFG staff as members, has repeatedly found that “[c]urrent delta smelt advice will be protective of longfin smelt larvae” and has not imposed additional OMR flow restrictions to protect longfin smelt (or to protect delta smelt, in the event FWS failed to do so). Goude Decl. at ¶ 4 & Ex. F (2009 SWG notes from 3/16, 3/23, 3/30, 4/6). If implementation of the RPA is enjoined, Environmental Intervenor argue that DFG likely would have a legal obligation to impose OMR flow restrictions to protect delta smelt and longfin smelt under state law. The nature of the requested injunction largely obviates this concern, as Plaintiffs merely request that FWS further justify any OMR flow restrictions under Component 2. To the extent that the deliberative process engenders any change to the manner in which FWS implements Component 2, FWS is nevertheless obliged to ensure that jeopardy and/or adverse modification is avoided.

35. Plaintiffs maintain that further explanation is warranted because it is not clear from the BiOp or FWS’s subsequent Decisions implementing the adaptive management protocol why flows have been set at the chosen, allegedly overprotective levels, without considering the adverse environmental consequences and irreparable injury this major federal action will cause.

*5. Balance of the Harms.*

*a. Potential Harm to the Species.*

36. Federal Defendants and Environmental Intervenor maintain that enjoining implementation of the RPA would irreparably harm the species. <sup>FN12</sup> Federal Defendants argue that, although “[w]e cannot know exactly what effect unlimited pumping would have on the delta smelt this year because it would depend on hydrologic conditions in the Delta and the geographic distribution of the delta smelt popula-

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tion.... unless conditions are favorable, it could entrain up to 50% of delta smelt larvae and cause a severe reduction in production, which would have a 'substantial' effect on the species." Doc. 56 at 21 (citing BiOp at 164–65).

**FN12.** As a threshold matter, Federal Defendants frame Plaintiffs' proposal as one that would permit "unlimited pumping." Doc. 56 at 20–21. Plaintiffs complain that this "is a straw man argument" insofar as they have not requested "unlimited pumping," because various other legal mandates make truly unlimited pumping out of the question. Doc. 70 at 2. However, it appears that Federal Defendants use the term "unlimited" to mean a pumping regime that is not constrained by Component 2. Federal Defendants' argument that "unlimited pumping could cause irreparable harm to the delta smelt" will be interpreted in this light.

**\*22 37.** FWS's May 21, 2009 Decision regarding Component 2 implementation indicates that salvage increased during the week prior and that, at the current rate, salvage "may exceed the Concern Level in the 2008 biological opinion of 299 delta smelt." Fed. Def. Ex. B. FWS further noted that delta smelt are "likely just starting to reach a size that they are more effectively detected at the fish salvage facilities. As the fish get larger, they will be detected more frequently. Also, the end of May is historically a period when high numbers of delta smelt become entrained at the export facilities. Salvage usually starts at the CVP before the SWP also salvages delta smelt. Currently, delta smelt have been salvaged at the CVP over the past 4 days." *Id.*

38. The ESA embodies a policy of "institutionalized caution." *Tennessee Valley Auth. v. Hill*, 437 U.S. 153, 194 (1978). It is not inappropriate to err on the side of the species when there is substantial uncertainty, and it is reasonable to do so, so long as FWS does not do so arbitrarily or in violation of NEPA, by ignoring irreparable injury from environmental and related harms that will be effectuated by overzealous reductions of CVP flows. FWS must evaluate and avoid, to the extent practicable, irreparable harm to Plaintiffs resulting from unnecessarily overprotective RPA measures.

*b. Harm to Water Users & Dependent Communities.*

39. It is undisputed that current conditions are causing economic hardship for water users and the communities upon which they depend. There is also substantial evidence establishing additional, non-economic hardships, involving dislocation of families and related impacts, loss of school and tax revenue, widespread food insecurity, and adverse impacts to groundwater supply and quality, soil quality, and air quality.

40. Despite the general economic downturn and/or natural hydrologic conditions, as opposed to the BiOp's flow constraints, the Westside service areas are almost exclusively farmlands, and farm-related activities support the communities in that region. The absence of water supply directly impairs and harms all of these interests, even if there are concurrent causes. Federal Defendants "cannot control the weather," and the court "cannot hold [them] responsible for the absence of rain," [\*Alabama v. U.S. Army Corps of Eng'rs\*, 441 F.Supp.2d 1123, 1134 \(N.D.Ala.2006\)](#), or the effects of economic recession. Here, however, substantial evidence shows that the BiOp and RPA's flow constraints, and specifically Condition 2, if overzealously implemented, will worsen the water shortage, causing increased harm. NEPA required consideration of such agency-caused consequences. Federal Defendants failed to engage in this analysis.

a. Information contained within the declaration of Ronald Milligan, Doc. 56–3, the manager of the Bureau's Central Valley Operations Office, indicates that total pumping by the CVP after May 17 would be reduced from 342,000 AF if OMR flows are set at –5000 cfs, to 90,000 AF if OMR flows are set at –1,250. This difference of 252,000 AF is substantial.

**\*23 41.** Plaintiffs have shown that irreparable harm will likely occur in the absence of injunctive relief, including loss of water supplies, damage to permanent crops, including orchards and vineyards, crop loss or reduction in crop productivity, job losses, reductions in public school enrollment, limitations on public services, impaired ability to reduce the toxic effects of salt and other minerals in the soil, groundwater overdraft, increased energy consumption, and land fallowing that causes air quality problems

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*c. Balance of the Hardships.*

42. The balance of the harms must be evaluated in light of the nature of the requested injunction. Plaintiffs request, that FWS be required to justify why it sets OMR flows at a particularly restrictive level, instead of at a level that would be less harmful to Plaintiffs' interests as federal contractors. The law does not require FWS to take any action that would imperil the continued survival and jeopardy of the smelt. the requested injunction requires FWS to, on an ad hoc basis, consider the issues it would have evaluated had it engaged in a NEPA review of the BiOp and RPA. Such an injunction will not subject the species to any harm. In this light, the balance of the harms tips strongly in favor of Plaintiffs.

*6. Public Interest.*

43. The public interest favors granting injunctive relief, as the harms cannot be remedied by monetary compensation, the environmental consequences cannot be avoided or reasonably mitigated, and the damage to the community is now occurring and will continue to be exacerbated.

**V. CONCLUSION AND ORDER.**

For the reasons set forth above, Plaintiffs' motion for Preliminary Injunction is GRANTED. FWS, its agents, and those acting in active concert or participation with them, are ENJOINED AND RESTRAINED as follows:

1. The FWS, its agents, and those acting in active concert or participation with them, are ENJOINED from setting and implementing unnecessarily restrictive OMR flow restrictions under BiOp RPA Component 2 unless and until FWS first considers the harm that these decisions and actions are likely to cause humans, the community, and the environment, during the period through June 30, 2009, or three consecutive days when water temperatures exceed 25°C, whichever first occurs. FWS, an agency with expertise in biology, not economics or sociology, need not independently evaluate and/or weigh the harms to humans, the community, and the environment versus any potential harm to the species. Rather, in light of the likelihood that Plaintiffs will succeed on their claim that the BiOp was unlawfully issued without NEPA compliance and the alternatives analysis such compliance would have required, FWS must explain why alternative, less restrictive OMR flows would not adequately protect the delta smelt,

considering location, abundance, entrainment, and all other assessment criteria currently in use, to evaluate risk to the species.

2. If FWS, its agents, and those acting in active concert or participation with them, determine that OMR flow restrictions under BiOp RPA Component 2 must be imposed to protect the species, FWS must explain why alternative, less restrictive OMR flows would not adequately protect the delta smelt.

**\*24** 3. For each decision setting or implementing OMR flow restrictions under BiOp RPA Component 2, FWS, its agents, and those acting in active concert or participation with them shall provide to the Court, and all parties to this lawsuit, a written statement explaining why alternative, less restrictive OMR flows would not adequately protect the delta smelt. These written explanations shall be provided forthwith through the Court's electronic case filing system and by any additional means FWS desires. Such explanation shall be provided no less frequently than weekly, even if FWS maintains the same OMR flow restriction from one week to the next.

SO ORDERED.

E.D.Cal.,2009.

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## **APPENDIX DOC. 7**

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**H**

United States District Court,  
E.D. California.  
The CONSOLIDATED DELTA SMELT CASES.

Nos. 1:09-CV-00407 OWW DLB, 1:09-cv-00480-OWW-GSA, 1:09-cv-00422-OWW-GSA, 1:09-cv-00631-OWW-DLB, 1:09-cv-00892-OWW-DLB.  
May 27, 2010.

**Background:** Water districts, advocacy groups and other interested parties brought actions against United States government, challenging implementation of Reasonable and Prudent Alternative (RPA) addressing impacts of water projects on threatened delta smelt. After actions were consolidated, plaintiffs moved for preliminary injunction.

**Holdings:** The District Court, [Oliver W. Wanger](#), J., held that:

- (1) plaintiffs demonstrated likelihood of success on merits of National Environmental Policy Act (NEPA) claim;
- (2) plaintiffs demonstrated likelihood of success on merits of Endangered Species Act (ESA) claim; and
- (3) public interest factors favored granting of injunction.

So ordered.

West Headnotes

**[1] Environmental Law 149E 🔑701**

[149E](#) Environmental Law  
[149EXIII](#) Judicial Review or Intervention  
[149Ek699](#) Injunction  
[149Ek701](#) k. Preliminary injunction. [Most Cited Cases](#)

Water districts challenging implementation of Reasonable and Prudent Alternative (RPA) addressing impacts of water projects on threatened delta smelt demonstrated likelihood of success on merits of claim that government did not take “hard look” at

harms of implementing RPA as to human health, safety and environment, as required under National Environmental Policy Act (NEPA), for purposes of preliminary injunction; evidence established significant detrimental effects on human environment via RPA's restrictions on California water supply. National Environmental Policy Act of 1969, § 102(2)(C), [42 U.S.C.A. § 4332](#)(2)(C).

**[2] Environmental Law 149E 🔑688**

[149E](#) Environmental Law  
[149EXIII](#) Judicial Review or Intervention  
[149Ek677](#) Scope of Inquiry on Review of Administrative Decision  
[149Ek688](#) k. Plants and wildlife; endangered species. [Most Cited Cases](#)

Court reviews biological opinion (BiOp) prepared pursuant to Endangered Species Act (ESA) based upon evidence contained in administrative record. Endangered Species Act of 1973, § 2 et seq., [16 U.S.C.A. § 1531 et seq.](#)

**[3] Administrative Law and Procedure 15A 🔑676**

[15A](#) Administrative Law and Procedure  
[15AV](#) Judicial Review of Administrative Decisions  
[15AV\(A\)](#) In General  
[15Ak676](#) k. Record. [Most Cited Cases](#)

Judicial review under Administrative Procedure Act (APA) must focus on administrative record already in existence, not some new record made initially in reviewing court; parties may not use post-decision information as new rationalization either for sustaining or attacking agency's decision. [5 U.S.C.A. § 551 et seq.](#)

**[4] Administrative Law and Procedure 15A 🔑676**

[15A](#) Administrative Law and Procedure  
[15AV](#) Judicial Review of Administrative Decisions

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[15AV\(A\)](#) In General  
[15Ak676](#) k. Record. [Most Cited Cases](#)

Exceptions to administrative record review for technical information or expert explanation make such evidence admissible only for limited purposes, and those exceptions are narrowly construed and applied.

**[5] Administrative Law and Procedure 15A**  
760

[15A](#) Administrative Law and Procedure  
[15AV](#) Judicial Review of Administrative Decisions

[15AV\(D\)](#) Scope of Review in General  
[15Ak754](#) Discretion of Administrative Agency  
[15Ak760](#) k. Wisdom, judgment or opinion. [Most Cited Cases](#)

Reviewing court must defer to agency on matters within agency's expertise, unless agency completely failed to address some factor, consideration of which was essential to making informed decision.

**[6] Administrative Law and Procedure 15A**  
760

[15A](#) Administrative Law and Procedure  
[15AV](#) Judicial Review of Administrative Decisions

[15AV\(D\)](#) Scope of Review in General  
[15Ak754](#) Discretion of Administrative Agency  
[15Ak760](#) k. Wisdom, judgment or opinion. [Most Cited Cases](#)

Reviewing court may not substitute its judgment for that of agency concerning wisdom or prudence of agency's action.

**[7] Environmental Law 149E** 537

[149E](#) Environmental Law  
[149EXI](#) Plants and Wildlife  
[149Ek535](#) Public Plans, Projects, and Approvals; Agency Action  
[149Ek537](#) k. Consultation. [Most Cited Cases](#)

Action is "jeopardizing" under section of Endangered Species Act (ESA) prohibiting agency action likely to jeopardize continued existence of any endangered or threatened species, if it keeps species recovery far out of reach, even if species is able to cling to survival. Endangered Species Act of 1973, § 7(a)(2), [16 U.S.C.A. § 1536\(a\)\(2\)](#); [50 C.F.R. § 402.02](#).

**[8] Environmental Law 149E** 537

[149E](#) Environmental Law  
[149EXI](#) Plants and Wildlife  
[149Ek535](#) Public Plans, Projects, and Approvals; Agency Action  
[149Ek537](#) k. Consultation. [Most Cited Cases](#)

Under section of Endangered Species Act (ESA) prohibiting agency action likely to jeopardize continued existence of any endangered or threatened species, agency may not take action that tip species from state of precarious survival into state of likely extinction. Endangered Species Act of 1973, § 7(a)(2), [16 U.S.C.A. § 1536\(a\)\(2\)](#); [50 C.F.R. § 402.02](#).

**[9] Environmental Law 149E** 537

[149E](#) Environmental Law  
[149EXI](#) Plants and Wildlife  
[149Ek535](#) Public Plans, Projects, and Approvals; Agency Action  
[149Ek537](#) k. Consultation. [Most Cited Cases](#)

Under section of Endangered Species Act (ESA) prohibiting agency action likely to jeopardize continued existence of any endangered or threatened species, even where baseline conditions already jeopardize species, agency may not take action that deepens jeopardy by causing additional harm. Endangered Species Act of 1973, § 7(a)(2), [16 U.S.C.A. § 1536\(a\)\(2\)](#); [50 C.F.R. § 402.02](#).

**[10] Environmental Law 149E** 537

[149E](#) Environmental Law  
[149EXI](#) Plants and Wildlife

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[149Ek535](#) Public Plans, Projects, and Approvals; Agency Action  
[149Ek537](#) k. Consultation. [Most Cited Cases](#)

Under section of Endangered Species Act (ESA) prohibiting agency action likely to jeopardize continued existence of any endangered or threatened species, failure by agency to utilize best available science is arbitrary and capricious. Endangered Species Act of 1973, § 7(a)(2), [16 U.S.C.A. § 1536\(a\)\(2\)](#); [50 C.F.R. § 402.14\(g\)\(8\)](#).

#### [\[11\]](#) Environmental Law [149E](#) [537](#)

[149E](#) Environmental Law  
[149EXI](#) Plants and Wildlife  
[149Ek535](#) Public Plans, Projects, and Approvals; Agency Action  
[149Ek537](#) k. Consultation. [Most Cited Cases](#)

“Best available science” mandate of section of Endangered Species Act (ESA) prohibiting agency action likely to jeopardize continued existence of any endangered or threatened species sets basic standard that prohibits agency from disregarding available scientific evidence that is in some way better than evidence it relies on. Endangered Species Act of 1973, § 7(a)(2), [16 U.S.C.A. § 1536\(a\)\(2\)](#); [50 C.F.R. § 402.14\(g\)\(8\)](#).

#### [\[12\]](#) Administrative Law and Procedure [15A](#) [792](#)

[15A](#) Administrative Law and Procedure  
[15AV](#) Judicial Review of Administrative Decisions  
[15AV\(E\)](#) Particular Questions, Review of  
[15Ak784](#) Fact Questions  
[15Ak792](#) k. Technical, expert or scientific evidence. [Most Cited Cases](#)

When specialists express conflicting views, agency must have discretion to rely on reasonable opinions of its own qualified experts even if, as original matter, court might find contrary views more persuasive.

#### [\[13\]](#) Administrative Law and Procedure [15A](#)

#### [741](#)

[15A](#) Administrative Law and Procedure  
[15AV](#) Judicial Review of Administrative Decisions  
[15AV\(D\)](#) Scope of Review in General  
[15Ak741](#) k. In general. [Most Cited Cases](#)

#### Administrative Law and Procedure [15A](#) [784.1](#)

[15A](#) Administrative Law and Procedure  
[15AV](#) Judicial Review of Administrative Decisions  
[15AV\(E\)](#) Particular Questions, Review of  
[15Ak784](#) Fact Questions  
[15Ak784.1](#) k. In general. [Most Cited Cases](#)

Mere uncertainty, or fact that evidence may be weak, is not fatal to agency decision.

#### [\[14\]](#) Administrative Law and Procedure [15A](#) [749](#)

[15A](#) Administrative Law and Procedure  
[15AV](#) Judicial Review of Administrative Decisions  
[15AV\(D\)](#) Scope of Review in General  
[15Ak749](#) k. Presumptions. [Most Cited Cases](#)

Presumption of agency expertise may be rebutted if agency's decisions, although based on scientific expertise, are not reasoned.

#### [\[15\]](#) Administrative Law and Procedure [15A](#) [462](#)

[15A](#) Administrative Law and Procedure  
[15AIV](#) Powers and Proceedings of Administrative Agencies, Officers and Agents  
[15AIV\(D\)](#) Hearings and Adjudications  
[15Ak458](#) Evidence  
[15Ak462](#) k. Weight and sufficiency. [Most Cited Cases](#)

Agency cannot disregard available scientific evidence better than evidence on which it relies.

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**[16] Administrative Law and Procedure 15A**  
 759

[15A](#) Administrative Law and Procedure

[15AV](#) Judicial Review of Administrative Decisions

[15AV\(D\)](#) Scope of Review in General

[15Ak754](#) Discretion of Administrative Agency

[15Ak759](#) k. Technical questions. [Most Cited Cases](#)

Courts are not required to defer to agency conclusion that runs counter to that of other agencies or individuals with specialized expertise in particular technical area.

**[17] Environmental Law 149E**  701

[149E](#) Environmental Law

[149EXIII](#) Judicial Review or Intervention

[149Ek699](#) Injunction

[149Ek701](#) k. Preliminary injunction. [Most Cited Cases](#)

Water districts challenging implementation of Reasonable and Prudent Alternative (RPA) addressing impacts of water projects on threatened delta smelt demonstrated likelihood of success on merits of claim that government's use of gross salvage numbers to justify quantitative pumping restrictions did not utilize "best available science," as required under section of Endangered Species Act (ESA) prohibiting agency action likely to jeopardize continued existence of any endangered or threatened species, for purposes of preliminary injunction; expert consensus was that best available methodology involved use of normalized salvage data to analyze effect of river flows on smelt population. Endangered Species Act of 1973, § 7(a)(2), [16 U.S.C.A. § 1536\(a\)\(2\)](#); [50 C.F.R. § 402.14\(g\)\(8\)](#).

**[18] Environmental Law 149E**  537

[149E](#) Environmental Law

[149EXI](#) Plants and Wildlife

[149Ek535](#) Public Plans, Projects, and Approvals; Agency Action

[149Ek537](#) k. Consultation. [Most Cited](#)

[Cases](#)

Under Endangered Species Act (ESA), avoiding adverse modification of critical habitat is independent statutory basis for promulgation of Reasonable and Prudent Alternative (RPA). Endangered Species Act of 1973, § 7(b)(3)(A), [16 U.S.C.A. § 1536\(b\)\(3\)\(A\)](#).

**[19] Environmental Law 149E**  537

[149E](#) Environmental Law

[149EXI](#) Plants and Wildlife

[149Ek535](#) Public Plans, Projects, and Approvals; Agency Action

[149Ek537](#) k. Consultation. [Most Cited Cases](#)

Federal action agency may not rely solely on biological opinion (BiOp) to establish conclusively its compliance with its substantive obligations under section of Endangered Species Act (ESA) prohibiting agency action likely to jeopardize continued existence of any endangered or threatened species. Endangered Species Act of 1973, § 7(a)(2), [16 U.S.C.A. § 1536\(a\)\(2\)](#); [50 C.F.R. 402.15\(a\)](#).

**[20] Environmental Law 149E**  537

[149E](#) Environmental Law

[149EXI](#) Plants and Wildlife

[149Ek535](#) Public Plans, Projects, and Approvals; Agency Action

[149Ek537](#) k. Consultation. [Most Cited Cases](#)

Under section of Endangered Species Act (ESA) prohibiting agency action likely to jeopardize continued existence of any endangered or threatened species, federal action agency must not blindly adopt conclusions of consultant agency. Endangered Species Act of 1973, § 7(a)(2), [16 U.S.C.A. § 1536\(a\)\(2\)](#); [50 C.F.R. 402.15\(a\)](#).

**[21] Environmental Law 149E**  700

[149E](#) Environmental Law

[149EXIII](#) Judicial Review or Intervention

[149Ek699](#) Injunction

[149Ek700](#) k. In general. [Most Cited Cases](#)

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Although all harms may be considered in evaluating claim for injunctive relief under National Environmental Policy Act (NEPA), injunction should not issue if enjoining such government action would result in more harm to environment than denying injunctive relief. National Environmental Policy Act of 1969, § 2 et seq., [42 U.S.C.A. § 4321 et seq.](#)

**[22] Environmental Law 149E  701**

[149E](#) Environmental Law

[149EXIII](#) Judicial Review or Intervention

[149Ek699](#) Injunction

[149Ek701](#) k. Preliminary injunction. [Most Cited Cases](#)

Public interest factors favored granting of preliminary injunction in action brought under National Environmental Policy Act (NEPA) and Endangered Species Act (ESA), challenging implementation of Reasonable and Prudent Alternative (RPA) addressing impacts of water projects on threatened delta smelt; relief would have benefited substantial population of water users in California, with respect to reducing adverse harms of destruction of permanent crops and fallowed lands, as well as increased groundwater consumption. Endangered Species Act of 1973, § 2(a)(3), [16 U.S.C.A. § 1531\(a\)\(3\)](#); National Environmental Policy Act of 1969, § 2, [42 U.S.C.A. § 4321](#).

\***1023** [Audrey M. Huang](#), [Paul S. Weiland](#), [John J. Flynn, III](#), [Robert C. Horton](#), Nossaman LLP, Irvine, CA, [Christopher J. Carr](#), Morrison and Foerster LLP, San Francisco, CA, [Daniel Joseph O'Hanlon](#), [Hanspeter Walter](#), [William Thomas Chisum](#), Kronick, Moskovitz, Tiedemann & Girard Eileen M. Diepenbrock, [Jonathan R. Marz](#), [Jon David Rubin](#), Diepenbrock \***1024** Harrison, Brandon Murray Middleton, [Damien Michael Schiff](#), [James S. Burling](#), M. Reed Hopper, Pacific Legal Foundation, [Brenda Washington Davis](#), [Leslie R. Wagley](#), The Brenda Davis Law Group, Sacramento, CA, [Charles Wesley Strickland](#), Brownstein Hyatt Farber and Schrek LLP, Santa Barbara, CA, [Mark J. Mathews](#), PHV, [Geoffrey M. Williamson](#), PHV, [Martha F. Bauer](#), PHV, [Michelle C. Kales](#), PHV, [Steve O. Sims](#), PHV, Brownstein Hyatt Farber Schreck LLP, Denver, CO, [Gary William Sawyers](#), Law Offices of Gary W. Sawyers, Harold Craig Manson, [Thomas William Birmingham](#), Westlands Water District, Fresno, CA,

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FINDINGS OF FACT AND CONCLUSIONS OF  
LAW RE PLAINTIFFS' REQUEST FOR  
PRELIMINARY INJUNCTION AGAINST  
IMPLEMENTATION OF RPA COMPONENT 2

(a/k/a Action 3) (Doc. 433)

[OLIVER W. WANGER](#), District Judge.

I. INTRODUCTION

Plaintiffs, San Luis & Delta Mendota Water Authority (the "Authority") and Westlands Water District ("Westlands"), move for a preliminary injunction ("PI") against the implementation of Reasonable and Prudent Alternative ("RPA") Component 2 set forth in the United States Fish and Wildlife Service's ("FWS") December 15, 2008 Biological Opinion, which addresses the impacts of the coordinated operations of the federal Central Valley Project ("CVP") and State Water Project ("SWP") on the threatened delta smelt (*Hypomesus transpacificus*) ("2008 Smelt BiOp" or "BiOp"). Doc. 433.

Plaintiffs State Water Contractors; Metropolitan Water District of Southern California; Kern County Water Agency and Coalition for a Sustainable; Stewart & Jasper Orchards, et al.; and the Family Farm Alliance join in the motion. Docs. 449, 451 & 453. Plaintiff-Intervenor Department of Water Resources ("DWR"), the operator of the SWP, partially joins. Doc. 452.

Federal Defendants and Defendant Intervenor opposed. Docs. 469, 473. Plaintiffs replied. Docs. 487, 491, 495, 497 & 507. The motion came on for an evidentiary hearing on April 2, 5, 6, and 7, 2010. Docs. 644, 652, 653 & 654. The parties were represented by counsel, as noted in the record.

After consideration of the testimony of the witnesses, the exhibits received in evidence, the written briefs of the parties, oral arguments, and the parties'

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proposed findings of fact and conclusions of law, the following findings of fact and conclusions of law concerning the motion for interim relief/preliminary injunction are entered.

To the extent any finding of fact may be interpreted as a conclusion of law or any conclusion of law may be interpreted as a finding of fact, it is so intended.

## II. BACKGROUND

The 2008 Smelt BiOp, prepared pursuant to Section 7 of the Endangered Species Act (“ESA”), [16 U.S.C. 1536\(a\)\(2\)](#), concluded that “the coordinated operations of the CVP and SWP, as proposed, are likely to jeopardize the continued existence of the delta smelt” and “adversely modify delta smelt critical habitat.” BiOp at 276-78. \*1025 As required by law, the BiOp includes an RPA designed to allow the projects to continue operating without causing jeopardy to the species or adverse modification to its critical habitat. *Id.* at 279. The RPA includes various operational components designed to reduce entrainment of smelt during critical times of the year by controlling exports out of and water flows into the Delta. *Id.* at 279-85.

*Component 1* (Protection of the Adult Delta Smelt Life Stage) consists of two Actions related to Old and Middle River (“OMR”) flows.

- *Action 1*, which is designed to protect upmigrating delta smelt, is triggered during low and high entrainment risk periods based on physical and biological monitoring. Action 1 requires OMR flows to be no more negative than -2,000 cubic feet per second (“cfs”) on a 14-day average and no more negative than -2,500 cfs for a 5-day running average. *Id.* at 281, 329.
- *Action 2* of Component 1 is designed to protect adult delta smelt that have migrated upstream and are residing in the Delta prior to spawning. Action 2 is triggered immediately after Action 1 ends or if recommended by the Smelt Working Group (“SWG”). Flows under Action 2 can be set within a range from -5,000 to -1,250 cfs, depending on a complex set of biological and environmental parameters. *Id.* at 281-82, 352-56.

At issue here is *Component 2* (Action 3) (Protec-

tion of Larval and Juvenile Delta Smelt), which requires OMR flows to remain between -1,250 and -5,000 cfs, beginning when Component 1 is completed, when Delta water temperatures reach 12 Celsius (“C”), or when a spent female smelt is detected in trawls or at salvage facilities. *Id.* at 282, 357-58. Component 2 remains in place until June 30 or when the Clifton Court Forebay water temperature reaches 25° C. *Id.* at 282, 368.

*Component 3* (Improve Habitat for Delta Smelt Growth and Rearing) requires sufficient Delta outflow to maintain average mixing point locations of Delta outflow and estuarine water inflow (“X2”) from September to December, depending on water year type, in accordance with a specifically described “adaptive management process” overseen by FWS. *Id.* at 282-83, 369.

Under *Component 4* (Habitat Restoration), DWR is to create or restore 8,000 acres of intertidal and subtidal habitat in the Delta and Suisun Marsh within 10 years. *Id.* at 283-84, 379.

Under *Component 5* (Monitoring and Reporting), the Projects gather and report information to ensure proper implementation of the RPA actions, achievement of physical results, and evaluation of the effectiveness of the actions on the targeted life stages of delta smelt, so that the actions can be refined, if needed. *Id.* at 284-85, 328, 375.

## III. SUMMARY OF MOTION

Plaintiffs' request temporary injunctive relief on the following grounds:

- 1) the district court has already found that the United States Bureau of Reclamation (“Reclamation”) failed to comply with the National Environmental Policy Act (“NEPA”) in implementing the 2008 Smelt BiOp RPA; and.
- 2) the 2008 Smelt BiOp violates the ESA and is arbitrary, capricious, and contrary to law because:
  - a) various aspects of the BiOp's baseline and effects analysis are flawed, undermining the overall jeopardy conclusion, causing overstatement of the effects of the proposed action and imposition of overly-broad and overly-restrictive RPA

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Components;

\***1026** b) the severe OMR flow restrictions in RPA Components 1 and 2 are unsupported by the best available science and the data in the 2008 Smelt BiOp; and

c) Component 3 (“The Fall X2 Action”) is arbitrary and capricious, because it is without factual or scientific justification and/or is not supported by the best available science, compelling a finding of likelihood of success on the merits.

Plaintiffs further claim that the implementation of RPA Components 1 and 2 will cause them continuing irreparable harm and that the public interest and balance of hardships favor injunctive relief.

RPA Component 1 has ended for the 2009-2010 water year, mooted any request for injunctive relief against its imposition. Component 3 is not set to begin until September, and Plaintiffs do not presently seek injunctive relief against its operation. Barring unforeseen circumstances, the parties' cross-motions for summary judgment will be heard and decided before September. Components 1 and 3 are not addressed in this decision.<sup>[FNI](#)</sup>

<sup>[FNI](#)</sup>. During the evidentiary hearing, Plaintiffs argued that testimony regarding Component 3 should be heard because it is relevant to their likelihood of success on the merits. But, even if Plaintiffs were likely to succeed on their claim that Component 3 is arbitrary and capricious, such a finding would have no bearing on the propriety of issuing an injunction against the operation of Component 2. The factual and legal arguments concerning Component 3 are voluminous. In light of Plaintiffs' request that this motion be resolved with all deliberate haste, Component 3 is not addressed at this time.

Plaintiffs' injunction request has been modified over time. Originally, Plaintiffs sought an injunction against implementation of RPA Component 2 and enforcement of the incidental take limits in the BiOp. *See* Doc. 435 at 2-4.

- In place of Component 2, Plaintiffs sought to re-

quire Federal Defendants and DWR to use a Potential Entrainment Index (“PEI”) to estimate cumulative entrainment loss of delta smelt. If the PEI estimate of cumulative loss is less than or equal to 7%, no pumping restrictions should be imposed; if the PEI estimate of cumulative entrainment loss exceeds 7%, FWS shall be responsible for setting OMR flows under the range specified in Component 2 of the BiOp. Doc. 435 at 3.

- Plaintiffs requested that the Incidental Take Statement (“ITS”) be recalculated based on a higher Cumulative Salvage Index (“CSI”) of 11.36 for adults. Doc. 435 at 4.

- In the alternative, if the above remedies are not imposed, DWR requested that the Court impose the interim remedial operational conditions imposed following summary judgment in *NRDC v. Kempthorne*, 1:05-cv-1207. Doc. 452 at 2.

Although Plaintiffs never filed a written modification of their request for relief, at the evidentiary hearing Plaintiffs withdrew their request to enjoin enforcement of the ITS and their request to implement the PEI in place of RPA Component 2 of the RPA. 4/2/10 Tr. 90:4-12; 4/7/10 Tr. 243:23-244:8. Instead, Plaintiffs now propose that Component 2 be replaced by a flat -5,600 cfs ceiling on negative OMR flows during the remainder of the implementation period for Component 2. *Id.*; *see* 4/2/10 Tr. 208.

#### IV. STANDARD OF DECISION

Injunctive relief, whether temporary or permanent, is an “extraordinary remedy, never awarded as of right.” \***1027** *Winter v. Natural Resources Defense Council*, 555 U.S. 7, 129 S.Ct. 365, 376, 172 L.Ed.2d 249 (2008); *Weinberger v. Romero-Barcelo*, 456 U.S. 305, 312, 102 S.Ct. 1798, 72 L.Ed.2d 91 (1982). Four factors must be established by a preponderance of the evidence to qualify for temporary injunctive relief:

1. Likelihood of success on the merits;
2. Likelihood the moving party will suffer irreparable harm absent injunctive relief;
3. The balance of equities tips in the moving parties' favor; and

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4. An injunction is in the public interest.

[Winter](#), 129 S.Ct. at 374; [Am. Trucking Ass'n v. City of Los Angeles](#), 559 F.3d 1046, 1052 (9th Cir.2009).

## V. FINDINGS OF FACT

### A. The Agency Action.

1. The agency action is the coordinated operation of the CVP and SWP, pursuant to an Agreement for the Coordinated Operation of the two projects ("OCO").

2. According to the Rivers and Harbors Act of 1937, the dams and reservoirs of the CVP "shall be used, first, for river regulation, improvement of navigation and flood control; second, for irrigation and domestic uses; and, third, for power." 50 Stat. 844, 850.

3. The CVP was reauthorized in 1992 through the Central Valley Improvement Act ("CVPIA"), which modified the 1937 Act and added mitigation, protection, and restoration of fish and wildlife as co-equal project purposes. [Pub.L. 102-575 § 3402, 106 Stat. 4600](#), 4706 (1992). One of the stated purposes of the CVPIA is to address impacts of the CVP on fish and wildlife. 3406(a). The CVPIA made environmental protection and water deliveries co-purposes.

4. This case presents a critical conflict between these dual legislative purposes, providing water service for agricultural, domestic, and industrial use, versus enhancing environmental protection for fish species whose habitat is maintained in rivers, estuaries, canals, and other waterways that comprise the Sacramento-San Joaquin Delta.

5. It is of manifest significance to the public interest that DWR, a co-operator and the State contractual partner of Reclamation, disagrees with at least some portions of the RPA and seeks injunctive relief against the calendar-based ceiling in RPA Component 2.

### B. Facts Relevant to NEPA Claim.

6. It is undisputed that neither FWS nor Reclamation engaged in any NEPA analysis in connection with preparation or implementation of the 2008 Smelt

BiOp.

7. It is also undisputed that on November 13, 2009, [686 F.Supp.2d 1026 \(E.D.Cal.2009\)](#), the Court entered an Order granting San Luis Plaintiffs' motion for summary judgment on their claim that Federal Defendants violated NEPA when they implemented the 2008 Smelt BiOp without conducting the required NEPA analysis. Doc. 399.

8. FWS did not engage in a systematic consideration of impacts to the human environment and/or consideration of alternatives that took into account those impacts, ordinarily performed as part of a NEPA review.

### C. Facts Relevant to ESA Challenges.

#### (1) Status of the Species.

9. The delta smelt was listed as a threatened species under the ESA on March 5, 1993. [58 Fed.Reg. 12,584 \(March 5, 1993\)](#). Critical habitat was designated for the delta smelt on December 19, 1994. [59 Fed.Reg. 65,256 \(Dec. 19, 1994\)](#).

**\*1028** 10. The threatened delta smelt, one of the most abundant species in the Bay-Delta ecosystem as recently as thirty years ago, is in imminent danger of extinction. Doc. 94, Findings of Fact Re Plaintiffs' Motion for Preliminary Injunction, 1-2. The experts agree that there is no current population count for delta smelt. 4/2/10 Tr. 174 (Feyrer); 4/5/10 Tr. 67 (Newman); 4/5/10 Tr. 231 (Hilborn); 4/6/10 Tr. 95 (Deriso). However, the species' relative abundance from year-to-year is monitored using the Fall Midwater Trawl index ("FMWT") prepared by the California Department of Fish and Game ("CDFG"), as well as other abundance indices. 4/2/10 Tr. 174-75. The FMWT shows a continuously and precipitously declining trend in delta smelt abundance in recent years, registering a series of record-breaking lows. 4/2/10 Tr. 176-78. That trend has continued in the last two years, with the FMWT declining from 23 in 2008 to 17 in 2009, the lowest value ever recorded. *Id.* The population growth rate for delta smelt has been "quite negative" for the last ten years. 4/5/10 Tr. 232. The stock-recruitment relationship for delta smelt, which shows the relationship between adults (i.e., the "stock" of the population) to juveniles recruited into the population, is "trending toward the origin," the

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opposite direction from recovery. 4/2/10 Tr. 187-88. “There’s no question that [the present abundance levels of delta smelt] are very low.” 4/5/10 Tr. 232 (Hilborn).

11. FWS recently determined that delta smelt warranted uplisting from threatened to endangered, but that the action was currently precluded by higher priority listing actions. 4/7/10 Tr. 163; [75 Fed.Reg. 17,667 \(Apr. 7, 2010\)](#). The direct mortality of delta smelt by entrainment at the CVP and SWP pumps, as well as the destruction and adverse modification of its habitat caused by water exports, were important factors in this determination. [75 Fed.Reg. at 17,671](#) (“The operation of State and Federal export facilities constitute a significant and ongoing threat to delta smelt through direct mortality by entrainment”). As a result of the “immediate and high magnitude threats” confronting the species, the delta smelt was assigned a listing priority number of 2. [FN2](#) *Id.* at 17,675.

[FN2](#). “Warranted but precluded” species are assigned listing priority numbers from 1 to 12, with 1 being the highest priority. *Id.* at 17,674.

12. Evidence submitted during trial indicates that, as of the dates of the March Spring Kodiak Trawl (March 8-11, 2010) and 20 mm surveys (March 15-18, 2010), delta smelt were collected in the northern and western portions of the Delta, not in the danger zones of the central or south Delta. SWC Exs. 918 & 919. Through March 28, 2010, the SWP had an expanded salvage of 16 delta smelt, and the CVP had an expanded salvage of 28 delta smelt. SWC Ex. 915.

13. Plaintiffs are correct that during the three years that restrictions on spring exports have been in place, the FMWT index has continued to trend downward. 4/7/10 Tr. 94:8-14. However, Mr. Grimaldo testified that improved conditions may not immediately translate into improved survival and population growth. 4/7/10 Tr. 120:9-25.

(2) *Baseline Issues.*

a. *Comparison of CalSim and Dayflow Data.*

14. CalSim II (“CalSim”) is a computer model developed jointly by DWR and Reclamation. The model simulates SWP and CVP operations and is the standard planning tool for evaluating project opera-

tions. 4/2/10 Tr. 101:24-102:6. The first version of the CalSim model was available in May \*1029 2002. It is continuously updated. 4/2/10 Tr. 102:7-13.

15. CalSim simulates SWP and CVP reservoir operations, project exports and water deliveries, flow through the Delta, and salinity requirements in the Delta, including the location of X2. 4/2/10 Tr. 102:14-20; BiOp at 207.

16. X2 is the location in the Delta where the salinity is two parts per thousand. It is measured as the distance upstream from the Golden Gate. 4/2/10 Tr. 102:21-24.

17. The CalSim model assumes 82 years of hydrology, 4/2/10 Tr. 101:23-102:3, 103:14-18, 161:2-6, provides the model with data regarding inflow to reservoirs and other information affecting the water supply, 4/2/10 Tr. 103:19-23. The model also assumes a level of development, which reflects water demand resulting from a particular urban population level, agricultural production, and wildlife refuge needs, 4/2/10 Tr. 104:1-7, as well as the existence and effect of environmental regulations and environmental programs, 4/2/10 Tr. 103:14-18. The assumptions used in the CalSim studies were developed by representatives from FWS, the National Oceanic and Atmospheric Administration (“NOAA”), Reclamation, CDFG, and DWR. 4/2/10 Tr. 105:8-12.

18. The CalSim model assists scientists in making planning decisions by allowing comparisons between studies based on differing assumptions. *See* 4/2/10 Tr. 102:25-103:6. According to Aaron Miller, P.E., an expert qualified to offer opinions on the subject of the formulation and application of CalSim, CalSim is not designed, or intended to be used, to compare CalSim study outputs to actual “historic” data or to outputs from different models, including the Dayflow model. 4/2/10 Tr. 95:7-14; DWR Ex. 511 at 8.

19. CalSim study 7.0 was developed as the baseline study for the 2008 OCAP Biological Assessment (“2008 OCAP BA” or “BA”). Study 7.0 represents existing conditions, and assumes a 2005 level of development and a full environmental water account (“EWA”). 4/2/10 Tr. 104:8-20; 123:21-24, 146:3-6; BiOp at 207. Study 7.1 is a near-future conditions study. It assumes a 2005 level of development and a

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limited EWA. 4/2/10 Tr. 104:8-23; 123:21-25; BiOp at 207-08. Study 8.0 is a future conditions study. It assumes a 2030 level of development and a limited EWA. 4/2/10 Tr. 104:8-25; 123:21-124:2; BiOp at 208.

20. CalSim study 6.0 was designed to look at the differences between the prior CalSim model used in the 2004 OCAP BA and the new model used in the 2008 OCAP BA. 4/2/10 Tr. 104:8-15, 157:11-18.

21. Study 6.1 is similar to 6.0, but did not include the EWA and used an older version of the X2 estimate. 4/2/10 Tr. 104:8-17. Study 6.1 was prepared at the request of Reclamation biologists to assess changes in water project operations during the pelagic organism decline ("POD") era. 4/2/10 Tr. 149:18-24, 150:16-151:17, 158:8-13. Reclamation biologists compared study 6.1 against the 7.0 and 8.0 studies on pages 13-10 through 13-17 of the 2008 OCAP BA. 4/2/10 Tr. 149:12-24; AR 011057-011064.

22. Mr. Miller testified that study 6.1 should not have been used for comparison because it was not comparable to the other studies. 4/2/10 Tr. 156:25-157:8. Study 6.1 used the Kimmerer Monismith equation to estimate X2 and it, as well as study 6.0, did not completely reflect the new enhancements in the CalSim model developed after the 2004 OCAP BA. 4/2/10 Tr. 157:10-18; SLDMWA Ex. 12 at 205-206.

23. The CalSim 9.0 series of studies represents climate change scenarios. Study 9.0 represents a future condition to serve as a basis of comparison of the effects of climate change to sea level rise, \*1030 without the inclusion of (b)(2) or EWA. Study 9.1 represents a one-foot sea level rise, without the inclusion of (b)(2) and EWA. Studies 9.2 through 9.5 look at predicted changes in precipitation and temperature for the period 2010 to 2030, relative to conditions for the period 1971 to 2000. The 9.0 climate change scenarios were not intended to be directly compared to studies 7.08.0. 4/2/10 Tr. 105:1-5; BiOp at 208. Such a comparison is not valid because the studies make different assumptions regarding environmental programs. 4/2/10 Tr. 123:10-16.

24. In the BiOp, CalSim studies were compared to simulations of historic conditions generated using

the Dayflow model. 4/2/10 Tr. 107:4-7, 142:6-9. Dayflow is a model that estimates historic outflow based on historic precipitation, inflow, and exports, and estimates of delta island diversions. Dayflow also provides an estimate for the location of X2. 4/2/10 Tr. 107:8-14.

25. In the BiOp, FWS purports to quantify adult entrainment by comparing OMR flows from CalSim studies to historic OMR flows during 1967-2007. BiOp at 212-13. The BiOp depicts these results in Tables E-5b and E-5c in the BiOp, which are labeled "difference from historic median value to CalSim II model median value" and "difference from historic median salvage to predicted salvage based on ... CalSim II," respectively. *Id.* at 214. Tables E-5b and E-5c purport to quantify, as effects of the action, changes in OMR flows and entrainment using the Dayflow-generated historic data as the baseline and comparing that to CalSim study results. Based on these comparisons of CalSim data and Dayflow-generated historic data, the BiOp concludes, "adult entrainment is likely to be higher than it has been in the past under most operating scenarios, resulting in lower potential production of early life history stages in the spring in some years." BiOp at 213.

26. In another analysis in the BiOp, FWS purports to quantify the effects of the action on delta smelt habitat by comparing CalSim model projections of the location of X2 under the proposed action to the median location of X2 over the historical period 1967-2007, as simulated by Dayflow. BiOp at 235-36. Based on this comparison, the BiOp concludes "[t]he median X2 [locations] across the CalSim II modeled scenarios were 10-15 percent further upstream than actual historic X2 (Figure E-19)." *Id.* at 235. In reliance on these percent differences between CalSim-created data and historical data, the BiOp concludes "proposed action operations are likely to negatively affect the abundance of delta smelt." *Id.* at 236.

27. In the BiOp, FWS performed similar comparisons of CalSim data to Dayflow-simulated historic baseline data to quantify the effects of the action on larval and juvenile delta smelt. *See, e.g.*, BiOp at 219 (examining effect of action on larval and juvenile entrainment and stating "[t]he analysis is based on comparison of historical (1967-2007) OMR and X2 to the proposed action's predictions of these variables

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provided in ... [CalSim] studies 7.0, 7.1, 8.0, and 9.0-9.5”).

28. Mr. Miller explained that outputs from a CalSim study should not be compared to outputs from the Dayflow model because the assumptions used in the two models are significantly different. 4/2/10 Tr. 107:18-23, 136:10-18.

a. The CalSim model assumes a constant level of development. In contrast, the Dayflow model incorporates a continuous change in the level of development because the Dayflow model is using historical information as input. When comparing models to determine the effect of project operations, the best **\*1031** scientific practice is to keep the assumed level of development constant. 4/2/10 Tr. 107:15-108:15.

b. A CalSim study also assumes a constant regulatory environment, whereas Dayflow uses a regulatory environment that has changed over time. This difference renders any comparison between CalSim and Dayflow outputs unreliable. 4/2/10 Tr. 108:16-109:23.

c. CalSim also operates on a monthly time step, whereas Dayflow operates on a daily time step. The two models also operate to different guidelines. The Dayflow model incorporates a conservative operation to avoid violating a regulation. In contrast, the CalSim model operates strictly to that regulation. 4/2/10 Tr. 107:23-108:3, 109:24-110:9. Operating conservatively results in higher modeled outflow. 4/2/10 Tr. 110:10-14.

d. The differences in the model assumptions and in the way the models operate, as described above, cannot be quantified to calibrate the models. CalSim does not model or simulate historical conditions, so it cannot be calibrated to history. 4/2/10 Tr. 121:18-122:6, 161:2-6. Calibration would be “very difficult, nearly impossible, to do without [ ] developing a model designed to simulate historical conditions.” 4/2/10 Tr. 110:15-111:1. The CalSim model cannot currently predict X2 for historic years because it would require a new model. 4/2/10 Tr. 122:7-16.

e. The Dayflow historic time window that FWS reported using in the BiOp was 1967 to 2007. Cal-

Sim studies model water years 1992 through 2003. The BiOp's comparison of CalSim-modeled data to Dayflow-modeled data resulted in comparing different sets of water years. Mr. Miller testified that the best scientific practice regarding years of comparison would have been to use consistent time windows. 4/2/10 Tr. 116:18-117:21; 142:13-15.

f. The artificial neural network (“ANN”) and the Kimmerer Monismith equation (“KM equation”) are two methods of estimating X2. 4/2/10 Tr. 111:2-16. The CalSim studies used ANN to estimate the position of X2, because ANN can be adapted to address sea level rise. 4/2/10 Tr. 111:19-25. The Dayflow model uses the KM equation to estimate X2. 4/2/10 Tr. 111:2-8; DWR Ex. 510 at Fig. 2; DWR Ex. 511 at 15. The KM equation was developed using historical data, making the KM equation invalid for a sea level rise study. 4/2/10 Tr. 111:19-25.

g. At locations less than 75 kilometers (“km”) from the Golden Gate, the KM equation results in an X2 estimate greater than (or farther upstream than) the ANN estimate. In contrast, at locations greater than 75 km from the Golden Gate, the KM equation provides an estimate less than the ANN estimate. 4/2/10 Tr. 112:1-113:18, DWR Ex. 510 at Fig. 2.

29. Mr. Miller calculated the magnitude of error introduced into the BiOp by FWS's application of both the KM and the ANN methods of estimating X2. He replicated the 87 km value as the median estimate of X2 from CalSim study 7.0 using the ANN method, and, consistent with the BiOp, calculated the difference between the reported historic median of X2 [79 km] and the study 7.0 median [87 km] to be 10% [ (87 km-79 km)/79]. He then calculated the median X2 for the CalSim 7.0 study using the KM equation (instead of using ANN) to be 84 km (instead of 87 km). Finally, he identified the percent difference between the reported historic median estimate of X2 using the KM equation [79 km] and the CalSim study 7.0 median estimate of X2 using the KM equation **\*1032** [84 km] to be 6% [ (84 km-79 km)/79 km]. 4/2/10 Tr. 114:6-25; DWR Ex. 511 at 14-16; BiOp at 235-36.

30. FWS did not calculate X2 using the KM equation for the CalSim studies, as did Mr. Miller.

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Instead, it undertook a direct comparison. DWR Ex. 511 at 15. The BiOp reported a 10% difference between the reported historic median X2 and the CalSim study 7.0 X2 median. Calculating the percent difference between the historical median X2 and study 7.0 median X2 using the KM equation resulted in only a 6% difference. From this, Mr. Miller concluded that 40% of the difference between X2 as estimated by study 7.0 and the historical X2 baseline reported in the BiOp is error attributed entirely to the use of the KM equation to calculate the historical baseline X2 and the ANN equation to calculate the CalSim study 7.0 baseline. 4/2/10 Tr. 114:6-25; DWR Ex 511 ¶ 15.

31. Mr. Miller testified that the differences in the KM equation and the ANN method of estimating X2 has an effect on the BiOp's analysis of habitat area, which in turn effects the BiOp's prediction of smelt abundance (as measured by the Summer Towntet Survey Index). 4/2/10 Tr. 113:19-114:5; BiOp at 235236, 266-269.

32. Mr. Miller explained that correcting for the differences between the use of the KM and ANN methods to estimate X2 does not correct for all the biases inherent in comparing CalSim data to "historic" data. It is unknown which portion of the remaining 60% of difference is attributable to the proposed action, and which portion is due to the other identified biases. 4/2/10 Tr. 115:1-8; DWR Ex. 511 at 16.

33. Mr. Miller testified that when using CalSim study 7.0-designed as a current conditions baseline-instead of the "historic" baseline in the BiOp, and comparing study 7.0 to the near-future 7.1 study, X2 moved upstream 0.7 km. The percentage change in X2 from current to near-current conditions was 0.8%. Further, when comparing study 7.0 to study 8.0 (a 2030 level of development scenario), X2 moved upstream only 1.1 km, with a resultant percentage change in X2 of 1.2% from current to future conditions. 4/2/10 Tr. 128:18-129:11; DWR Ex. 511 at 20; BiOp at 235, 265. The 0.7 km change and the 1.1 km change, respectively, were vastly different from the approximately 8.7 km and 9.1 km changes shown in the BiOp (Figure E-19) using historical Dayflow as the baseline. BiOp at 265; DWR Ex. 511 at 7.

34. Using the equation identified in Figure E-20

in the BiOp, Mr. Miller calculated the reduction in suitable habitat consistent with the change in the position of X2. A comparison of CalSim study 7.0 with study 7.1 yielded a reduction in habitat area of 128 hectares, and a comparison of study 7.0 with study 8.0 yielded a reduction in habitat area of 289 hectares. 4/2/10 Tr. 129:12-130:5; DWR Ex. 511 at 20; BiOp at 266.

35. Plaintiffs assert that, prior to issuance of the BiOp, FWS was put on notice that comparing historical data to CalSim simulated data was an inappropriate and invalid methodology. 4/2/10 Tr. 133:15-134:11, 137:16-138:16, 138:21-139:14; SLDMWA Ex. 351 at 7; SLDMWA Ex. 261 at 5; SWC Ex. 933 at 3.

a. The 2008 OCAP BA did raise some cautionary notes:

CalSim II is intended to be used in a comparative mode. The results from a "proposed operation" scenario are compared to the results of a "base" scenario, to determine the incremental effects. The model should be used with caution to prescribe seasonal or to guide real-time operations, predict flows or water deliveries for any real-time operations. The results from a single simulation may not necessarily represent the exact operations for a \*1033 specific month or year, but should reflect longterm trends.

DWR Ex. 518.

b. DWR Deputy Director Jerry Johns, on October 24, 2008, submitted comments to FWS on the draft effects analysis, generally cautioning against the comparison of modeled data with actual data:

USFWS is using historic data for comparison to CalSim II simulations. Great caution should be taken when comparing actual data to modeled data. CalSim II modeling should be used in a comparative mode. In other words, it should be used to compare one set of model runs to another. For example, it would be appropriate to compare CalSim II modeling of one demand alternative to another to analyze the incremental effects.

AR 8671; *see also* AR 8668 (further explaining unreliability problems comparing historic and mod-

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eled data).

c. The State Water Contractors also cited a letter that they sent to FWS before the BiOp was completed. However, that letter only critiqued the comparison of simulated data to historical salvage data, and did not dispute with the comparison of CalSim-simulated to Dayflow-simulated historic data. 4/2/10 Tr. 133-34.

d. Mr. Miller acknowledged that, despite his heavy involvement in the modeling analysis underlying the BiOp, he did not present his *current* criticism of the use of the data to FWS during preparation of the BiOp. 4/2/10 Tr. 115-16.

36. FWS was not on notice of Mr. Miller's critiques regarding comparing simulated CalSim runs to simulated Dayflow runs, and was not put on notice by him that they were improperly using the specialized models. FWS did not have an opportunity to correct its modeling or address Plaintiffs' concerns.

37. The BiOp explains why FWS looked beyond CalSim. When CalSim was used to identify current Project operations, and these results were then compared to the results of a CalSim modeling run purportedly simulating past operations, the results "were nearly identical" despite significant operational changes in current operations as compared to past. BiOp at 204-05. The BiOp explains that "[t]he inaccuracies in CalSim [led FWS] to use actual data to develop an empirical baseline." *Id.* at 206. FWS "also developed historical time series data for hydrologic variables used in this effects analysis based on the Dayflow database ... and OMR data obtained from USGS." *Id.*

38. Mr. Miller asserts that best scientific practice would preclude FWS from comparing CalSim output to historic data generated by Dayflow. However, Mr. Miller acknowledged that in the 2008 OCAP BA, DWR and Reclamation compared CalSim output to historic data, albeit for a different purpose, namely to show that the timing and magnitude of reservoir and export operations were similar to historic operations. 4/2/10 Tr. 119-20. Mr. Miller acknowledged that other modelers involved in preparing the BA expressed concerns about using only CalSim data, and that the BA itself questioned the use of that data alone, as CalSim simulations did not provide "an especially satisfactory representation of pre-POD

water project operations." *Id.* at 150-51. The BA, prepared by DWR and Reclamation, states: "While we have not adopted an alternative statistical approach [to the use of CalSim model runs] in this biological assessment, we believe it would be a useful way to further assess changes in water project operations during the POD era and we recommend that [FWS] consider such an analysis as further refinement to this BA." *Id.* Other reputed scientists in the field agree with FWS and the BA that the \*1034 CalSim-generated modeling studies did not "generate[ ] baselines with a high degree of reliability." *Id.* at 160. Neither Mr. Miller nor DWR offered any alternative to Dayflow to FWS to address that serious shortcoming during preparation of the BiOp. *Id.* at 160-61.

39. Mr. Miller acknowledged that, even if the CalSim comparison had been conducted in the manner he recommends, it would have confirmed FWS's conclusions that Project operations as proposed in the BA move X2 further upstream in the fall, reducing the amount of habitat for delta smelt and modifying the quality of critical habitat by shifting the low salinity zone away from higher-quality habitat and further into the central Delta. *Id.* at 130. Mr. Miller did not suggest that this revision would result in a *de minimis* shift of X2.

40. Mr. Miller presents substantive criticisms of the BiOp's CalSim runs. These specific concerns were not raised before the agency prior to the BiOp's issuance. Moreover, FWS expressed legitimate concerns, shared with other scientists, about the exclusive reliance on CalSim runs. Mr. Miller concedes that even if his recommended approach had been taken, the same fundamental result would have obtained: project operations shift the position of X2 upstream. <sup>FN3</sup>

<sup>FN3.</sup> The magnitude of the shift, not its existence, and what should be done about it may be relevant to the need for and justification of RPA Component 3.

41. This highly technical dispute was not raised before the agency, and there were legitimate concerns about comparing CalSim modeling runs to other CalSim runs. This choice of competing methodologies is not sufficiently clear error to justify the court's intervention.

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b. *Treatment of “Other Stressors.”*

42. Plaintiffs raise a generic concern about how the BiOp treated the many other factors that are undeniably contributing to the decline of delta smelt including: (a) presence of aquatic macrophytes (submerged aquatic vegetation such as *Egeria densa* that may overwhelm delta smelt habitat); (b) predation; (c) introduction and propagation of invasive species, including inland silversides and the overbite clam that compete with the delta smelt; (d) presence of contaminants, such as pesticides and wastewater, in the Delta; and (e) presence of large blooms of blue-green algae toxic to the copepods eaten by delta smelt. BiOp at 182-86; 4/7/10 Tr. 148:17-19, 149:20-25.

43. Plaintiffs take particular issue with a statement in the very first paragraph of a section of the BiOp entitled “Effects of the Proposed Action.”

The Status of the Species/Environmental Baseline section of this document described the multitude of factors that affect delta smelt population dynamics including predation, contaminants, introduced species, entrainment, habitat suitability, food supply, aquatic macrophytes, and microcystis. The extent to which these factors adversely affect delta smelt is related to hydrodynamic conditions in the Delta, which in turn are controlled to a large extent by CVP and SWP operations. Other sources of water diversion (NBA, CCWD, local agricultural diversions, power plants) adversely affect delta smelt largely through entrainment (see following discussion), but when taken together do not control hydrodynamic conditions throughout the Delta to any degree that approaches the influence of the Banks and Jones export facilities. *So while many of the other stressors that have been identified as adversely affecting delta smelt were not caused by CVP and SWP operations, the likelihood \*1035 and extent to which they adversely affect delta smelt is highly influenced by how the CVP/SWP are operated in the context of annual and seasonal hydrologic conditions.* While research indicates that there is no single primary driver of delta smelt population dynamics, hydrodynamic conditions driven or influenced by CVP/SWP operations in turn influence the dynamics of delta smelt interaction with, these other stressors (Bennett and Moyle 1996).

BiOp at 202 (emphasis added).

44. The BiOp concludes that “the CVP and SWP have played an indirect role in the delta smelt’s decline by creating an altered environment in the Delta that has fostered the establishment of nonindigenous species and that exacerbates these and other stressors that are adversely impacting delta smelt.” BiOp at 203; 4/7/10 Tr. 152:5-12. Ms. Goude further testified that it is not possible to quantify the level of effects of those other factors. 4/7/10 Tr. 150:1-3.

45. When asked by the Court to identify any information in the record that supports the BiOp’s conclusion that project operations exacerbate the effect of other stressors, Dr. Thomas Quinn, an expert appointed under [Federal Rule of Evidence 706](#), concluded that “there does not appear to be evidence in the record demonstrating that project operations exacerbate the effect/impact of other stressors.” Doc. 633, Order Transmitting Responses from 706 Experts, Ex. A, at 20. Ms. Goude testified that she disagreed with this conclusion, but could not identify any evidence from the record to support her assertion. See 4/7/10 Tr. 201:22-203:9.

46. Dr. Andre Punt, another court-appointed expert, further explained the BiOp’s notion that indirect effects of the Projects may contribute to effects such as high water toxicity, suppression of phytoplankton, increase of overbite clams, and increase in encounters with unscreened agricultural diversions in the Delta are plausible hypotheses, but that “there are no direct data available to test them.” Doc. 633 at 21.

47. In contrast to the BiOp’s general statements assigning the blame for at least some, unquantified portion of the negative effects cause by these “other stressors” to the projects, elsewhere, the BiOp acknowledges that there is “no single primary driver of delta smelt population dynamics,” *id.* at 202, but rather that there are “multiple factors” and that “not all are directly influenced by operations of the CVP/SWP.” *Id.* at 328. “Other stressors” are discussed in detail throughout the BiOp. See, e.g., *id.* at 182-88, 198, 201-2. Specifically, FWS considered the effects of “predation, contaminants, introduced species ..., habitat suitability, food supply, aquatic macrophytes, and microcystis.” *Id.* at 202, 277. The BiOp expressly recognizes that the long-term decline

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of the species “was very strongly affected by ecosystem changes caused by non-indigenous species invasions and other factors....” *Id.* at 189.

48. Although the BiOp acknowledges that “not all” of the multiple factors negatively impacting the species “are directly influenced” by Project operations, the general assertion in the BiOp that other stressors are the result of (or at least exacerbated by) Project operations is not supported by the record. This error compounds the agency’s failure to address alternative approaches to avoiding jeopardy, including whether other stressors can be mitigated or eliminated, which NEPA requires.

(3) *Challenges to Component 2 (Action 3).*

49. Component 2 (Protection of Larval and Juvenile Delta Smelt) requires OMR flows to remain between -1,250 and -5,000 \*1036 cfs beginning when Component 1 is completed, when Delta water temperatures reach 12 Celsius, or when a spent female smelt is detected in trawls or at salvage facilities. *Id.* at 282, 357-358. Component 2 remains in place until June 30 or when Clifton Court Forebay water temperature reaches 25 Celsius, whichever first occurs. *Id.* at 282, 368.

50. The objective of Component 2 (which corresponds to Action 3 in Attachment B of the BiOp), is to “improve flow conditions in the Central and South Delta so that larval and juvenile delta smelt can successfully rear in the Central Delta and move downstream when appropriate.” BiOp 282.

51. The most recent smelt working group recommendation for the week of April 12, 2010 recommends OMR flows no more negative than -5,000 cfs because the “risk to larval delta smelt was low, given that no salvage of larvae has occurred so far this year and the latest survey data suggest that the greatest densities of delta smelt are in the Sacramento River and downstream of the confluence, and, therefore, outside the influence of the pumps.” [FN4](#)

[FN4](#). Judicial notice is taken of the existence and content of the Smelt Working Group Recommendation, dated April 12, 2010, available at: [http://www.fws.gov/sacramento/es/documents/ds\\_working\\_group/4-12-10%20notes.pdf](http://www.fws.gov/sacramento/es/documents/ds_working_group/4-12-10%20notes.pdf).

a. *Use of Raw Salvage to Justify the Quantitative Flow Restrictions.*

52. The BiOp quantitatively analyzed the effects of pumping at the Banks and Jones pumping plants. 4/6/10 Tr. 19:1-3; BiOp at 208-209.

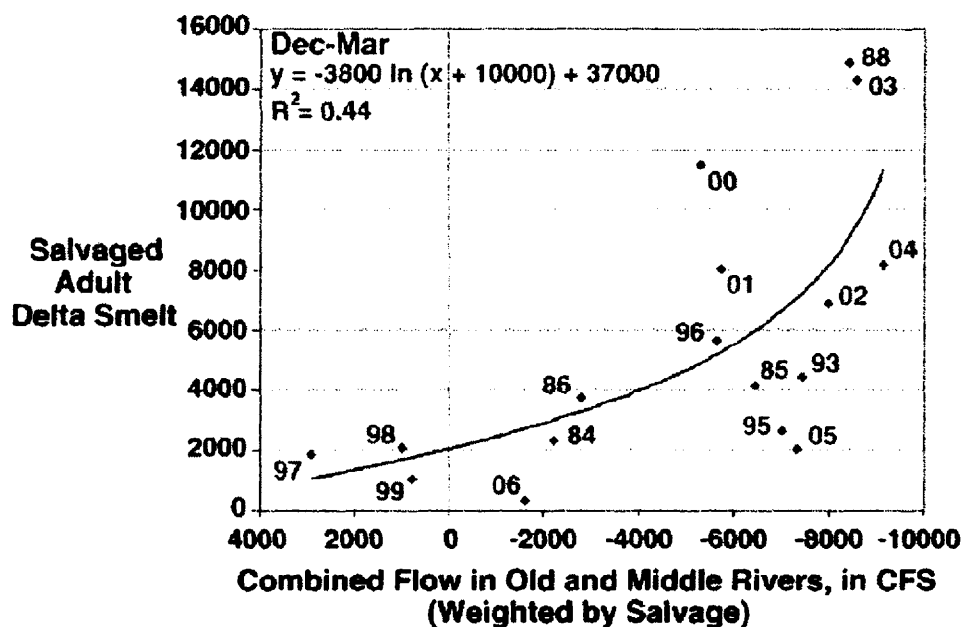
53. The results of that quantitative analysis, which compared OMR flows with gross salvage numbers, are described in Figures B-13 and B-14 of the BiOp. BiOp at 348, 350. These figures were presented as part of a three and-a-half page section of the BiOp entitled “Justification for Flow Prescriptions in Action 1.” BiOp at 347-51. It also appears that this analysis was relied upon to set the calendar-based flow prescription in Component 2 (Action 3), as no other basis for the -5,000 cfs ceiling is presented. Because this portion of the BiOp is critical to the present challenge, it is reproduced here in its entirety:

Justification for Flow Prescriptions in Action 1

Understanding the relationship between OMR flows and delta smelt salvage allows a determination of what flows will result in salvage. The OMR-Salvage analysis herein was initiated using the relationship between December to March OMR flow and salvage provided by P. Smith and provided as Figure B-13, below. Visual review of the relationship expressed in Figure B-13 indicates what appears to be a “break” in the dataset at approximately -5,000 OMR; however, the curvilinear fit to the data suggest that the break is not real and that the slope of the curve had already begun to increase by the time that OMR flows reached -5,000 cfs.

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Note: Data shown are for the period 1984-2007, excluding years 1987, 1989-92, 1994, and 2007 that had low (i.e. 12 cfs) average water turbidity during Jan-Feb at Clifton Court Forebay.

**Figure B-13. OMR-Salvage relationship for adult delta smelt. (source, P. Smith). Data from this figure were the raw data used in the piecewise polynomial regression analysis.**

Further, a nonlinear regression was performed on the dataset, and the resulting pseudo- $R^2$  value was 0.44-suggesting that although the curvilinear fit is a reasonable description of the data, other functional relationships also may be appropriate for describing the data. Fitting a different function to the data could also determine the location where salvage increased, i.e. identify the “break point” in the relationship between salvage and OMR flows. Consequently, an analysis was performed to determine if the apparent break at -5,000 cfs OMR was real. A piecewise polynomial regression, sometimes referred to as a multiphase model, was used to establish the change (break) point in the dataset.

A piecewise polynomial regression analysis with a linear-linear fit was performed using data from 1985 to 2006. The linear-linear fit was selected because it was the analysis that required the fewest parameters to be estimated relative to the amount of variation in the salvage data. Piecewise polynomial regressions were performed using Number Cruncher Statistical Systems (© Hintz, J., NCSS and PASS, Number Cruncher Statistical Systems, Kaysville UT).

The piecewise polynomial regression analysis resulted in a change point of -1162, i.e. at -1162 cfs OMR, the slope changed from 0 to positive (Figure B-14). These results indicate that there is a relatively constant amount of salvage at all flows more positive than -1162 cfs but that at flows more negative than -1162, salvage increases. The pseudo- $R^2$  value was 0.42, a value similar to that obtained by P. Smith in the original analysis.

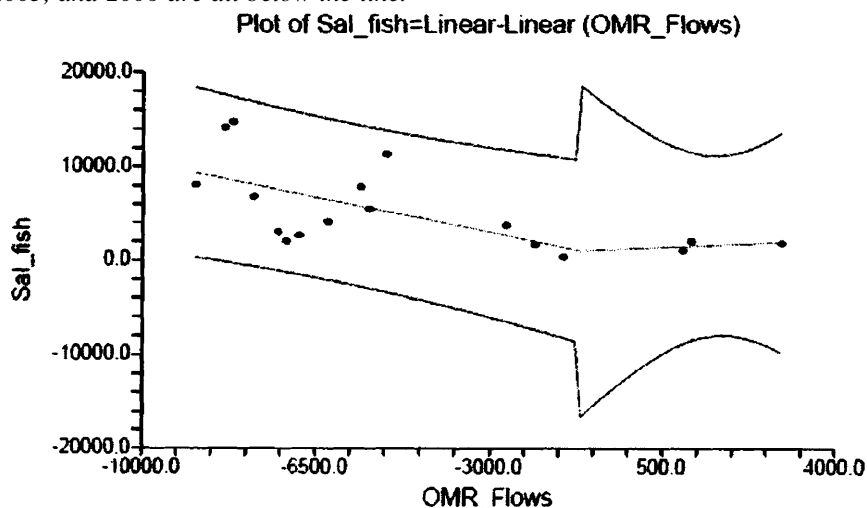
**\*1038** To verify that there was no natural break at any other point, the analysis was performed using a linear-linear-linear fit (fitting two change points). The linear-linear-linear fit resulted in two change points, -1,500 cfs OMR and -2,930 cfs OMR. The -1,500 cfs value is again the location in the dataset at which the slope changes from 0 to positive. The pseudo- $R^2$  value is 0.42 indicating that this relationship is not a better description of the data. Because of the additional parameters estimated for the model, it was determined that the linear-linear-linear fit was not the best function to fit the data, and it was rejected. No formal AIC analysis was performed because of the obvious outcome.

**EXHIBIT 3**  
**(Part 3 of 3)**

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A major assumption of this analysis is that as the population of Delta smelt declined, the number of fish at risk of entrainment remained constant. If the number of fish in the vicinity of the pumps declined, fewer fish would be entrained and more negative OMR flows would result in lower salvage. This situation would result in an overestimate, i.e. the change point would be more positive. In fact, if the residuals are examined for the relationship in Figure B-13 above, the salvage for the POD years 2002, 2004, 2005, and 2006 are all below the line.

2003 is above the line although the line is not extended to the points at the top of the figure, and these data points occur when the curve becomes almost vertical. The negative residuals could be a result of a smaller population size available for entrainment and salvage. This could be verified by normalizing the salvage data by the estimated population size based on the FMWT data.



**Figure B-14. Piecewise polynomial regression of OMR flows and salvage. The change point is the location at which the two regression lines meet; -1,162 cfs OMR.**

The original values of OMR and salvage could have been measured with error due to a number of causes, consequently the values used in the original piecewise polynomial analysis could be slightly different than the “true” values of salvage and OMR flow. Consequently, a second analysis was undertaken to examine the effect of adding stochastic variation to the OMR and salvage values in the \*1039 piecewise polynomial regression analysis. The correlation between OMR and salvage in the original dataset was -0.61 indicating that the more negative the OMR, the greater the salvage. Consequently, it was necessary to maintain the original covariance structure of the data when adding the error terms and performing the regressions. The original covariance structure of the OMR-salvage data was maintained by adding a random error term to both parameters. The random error term was added to OMR and a correlated error term was

added to salvage. The expected value of the correlated errors was -0.61.

The error terms were selected from a normal distribution with a mean of 1.0 and a standard deviation of 0.25 which provided reasonable variability in the original data. Operationally this process generated a normal distribution of OMR and salvage values in which the mean of the distributions were the original data points. Additional analyses were performed with standard deviations of 0.075, 0.025, and 0.125. Smaller standard deviations in the error term resulted in estimates of the change point nearer to the original estimate of -1,162 cfs. This is to be expected as the narrower the distribution of error terms, the more likely the randomly selected values would be close to the mean of the distribution. The process was repeated one hundred times, each time a new dataset was generated and a new piecewise polynomial regression was per-

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formed. The software package @Risk (© Palisade Decision Tools) was used to perform the Monte Carlo simulations. Latin hypercube sampling was used to insure that the distributions of OMR and salvage values were sampled from across their full distributions. The parameter of interest in the simulations was the change point, the value of the OMR flow at which the amount of salvage began to increase. Incorporating uncertainty into the analysis moved the change point to -1,800 cfs OMR, indicating that at flows above -1683, the baseline level of salvage occurred but with flows more negative than -1683, salvage increased.

BiOp 347-51 (emphasis added).

54. The BiOp does not use this information to assert that entrainment has a statistically significant effect on the population of delta smelt every year. 4/7/10 Tr. 172. Rather, this information appears to be used to set “break points” above and below which entrainment rates noticeably change. In turn, these break points were utilized in the formation of the flow restrictions in the RPAs.

55. It is undisputed that the use of gross salvage does not account for the size (or relative size) of the smelt population, as estimated by reliable abundance indexes. 4/6/10 Tr. 22:10-11, 23:19. The BiOp admits as much, and concedes that the analysis “assumes that as the population of Delta smelt declined, the number of fish at risk of entrainment remained constant.” *See* emphasized text above.

56. Considering gross salvage numbers alone provides no means of distinguishing an event in which 10,000 fish are salvaged out of a population of 20,000 from an event in which 10,000 fish are salvaged from a population of 20 million. 4/6/10 Tr. 24:19-22.

57. FWS was aware of the problems with using gross salvage numbers before the completion of the BiOp. The August 26, 2008, draft meeting notes of FWS's Delta Smelt Action Evaluation Team state:

When analyzing the importance of entrainment to the species population structure or decline, the relevant fact to consider is the percentage of the population being removed via entrainment.\*1040 Salvage data, by itself, may not be sufficient to

help one understand the percentage of the population being removed via entrainment.

MWD Ex. 633 at 5.

58. The Independent Peer Review of FWS's draft Effects Analysis for the BiOp also recommended to FWS that it “normalize[ ]” salvage to population size:

The panel suggests that the use of predicted salvage of adult smelt should be normalized for population size. Total number salvaged is influenced by a variety of factors, particularly the number of fish in the population.... Expressing salvage as a normalized index may help remove some of the confounding of the temporal trends during the baseline.

MWD Ex. 608 at 8.

59. However, notwithstanding the recommendation of the Independent Peer Review and its own internal staff's recognition that salvage data should be normalized, FWS persisted in using raw salvage data and did not normalize or index the salvage data to the population size. BiOp at 348, 350. As a result, salvage numbers relied upon to justify the RPAs do not relate to any information regarding population-level effects. 4/6/10 Tr. 22:10-11, 23:19. This was unreasonable, not based on the best available science, arbitrary, and capricious.

60. This conclusion was supported by explanatory testimony of the experts. There was agreement among the testifying scientific experts that the use of normalized salvage data rather than gross salvage data is the standard accepted scientific methodology among professionals in the fields of fisheries biology/management. 4/5/10 Tr. 97:4-10, 143:25-144:1; 4/6/10 Tr. 30:15-22; Doc. 633, Ex. A, at 7, 10; 4/6/10 Tr. 31:11-16; MWD Ex. 608 at 6; Fed. Gov't Smelt Ex. 17 at 11.

a. The Federal Defendants' expert on biological statistics, Dr. Kenneth Newman, stated in his declaration that Federal Defendants should have “scale [ed] salvage by some measure of population abundance” and stated in his oral testimony that without indexing salvage to population there is “nothing to go on.” Fed. Gov't Smelt Ex. 17 at 11; 4/5/10 Tr.

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143:25-144:1.

b. Dr. Newman went on to state that the relevant factor to consider is the percentage of the smelt population being removed by entrainment and that salvage data by itself is not sufficient. 4/5/10 Tr. 97:4-10. Dr. Newman also stated that because Figure B-13 relates raw salvage to combined OMR flows, it does not enable the agency to determine the effect on the population of a particular OMR flow. 4/5/10 Tr. 100:11-15.

c. Dr. Punt found that “it was unreasonable (given that appropriate data and analysis methods were available to account for population size) to have only relied on the information in Fig. B-13 and Fig. B-14 rather than on an analysis in which salvage is expressed relative to population size.” Doc. 633, Ex. A, at 7. Dr. Deriso agreed. 4/6/10 Tr. 30:15-31:2.

d. Dr. Thomas Quinn, the other 706 expert, stated: “it is not clear why such an adjustment [of salvage to population size] was not made for the data examined in this report.” Doc. 633, Ex. A, at 10. Dr. Deriso agreed. 4/6/10 Tr. 31:11-19.

61. The BiOp itself recognized the necessity of normalizing raw salvage data:

To provide context to determine the magnitude of effect of pre-spawning adult direct mortality through entrainment within any given season (as measured by salvage), it is necessary to consider two important factors. \*1041 The second factor to consider when relating salvage to population-level significance is that the total number salvaged at the facilities does not necessarily indicate a negative impact on the overall delta smelt population.

BiOp at 338.

62. August 26, 2008 meeting notes of the Delta Smelt Action Evaluation Team also indicate that FWS recognized and was aware of the need to analyze the percentage of the population removed by salvage, but neither these notes nor the BiOp explain why this analysis was not performed. MWD Ex. 633 at 5; 4/5/10 Tr. 96-97:14-10.

63. The BiOp, in fact, used normalized salvage data for other parts of its analysis, including the Incidental Take Statement, evidencing its ability to do so. BiOp at 386; 4/7/10 Tr. 196:18-20; *see also* 4/7/10 Tr. 199:14-21 (Cay Goude testifying that FWS understood the importance of using normalized salvage data and chose to use it in parts of the BiOp).

64. FWS did not explain its decision in the BiOp to use gross salvage numbers in Figures B-13 and B-14, and did not explain why it selectively used normalized salvage data in some parts of the BiOp but not in others. 4/6/10 Tr. 28:5-8, 32:5-9.

65. FWS presented no credible, scientifically based explanation for the decision to use gross salvage numbers instead of normalized salvage data in Figures B-13 and B-14, either in the BiOp or at the hearing. Other than endeavoring to structure a result, there is no explanation for this departure from best available science. This raises the spectre of bad faith.

66. For the purposes of (a) demonstrating the difference between the analysis presented in the BiOp and a population-normalized analysis and (b) identifying an appropriate interim remedy, Dr. Deriso analyzed the relationship between normalized salvage and OMR flows. This analysis revealed that there were no detectable trends in the juvenile salvage rate at flows up to -5,600 cfs, which is the most negative salvage weighted flow rate contained in the data. 4/6/10 Tr. 55:18-24; Fed. Gov't Smelt Ex. 18 at 25.

67. Federal Defendants criticize Dr. Deriso's alternative analysis in a number of ways:

a. Dr. Newman explained that Dr. Deriso's analysis is more appropriately characterized as a “first cut” at an analysis that fails to correct for potentially large “observation errors.” 4/5/10 Tr. 73, 77-78. Those “errors” include factors and variability that would tend to confound the results if not accounted for, such as temperature variations, geographic distribution, turbidity, or predation, all of which can “distort[,] confuse or confound” the relationship between the factors one is trying to examine. *Id.* at 51 (Dr. Newman's testimony regarding the factors he will be addressing and including in his forthcoming delta smelt life cycle model). He opined that some of these confounding factors are

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very important and ignoring them could lead one “[e]ither to wrongly assume that there is a relationship or to assume that there is [one] when there isn’t.” *Id.* at 82. This concern was reiterated by Dr. Rose in his 2000 paper, and by Dr. Hilborn. *Id.* at 160-61.

b. Dr. Newman ran his own analysis, applying a different standard statistical methodology, on the same cumulative salvage index versus OMR flow data used by Dr. Deriso, and got different results regarding the “inflection point” where OMR flows had an increasing impact on the population-normalized salvage rate. 4/5/10 Tr. 63-64. Ultimately, Dr. Newman testified that he would have performed a statistical analysis different from those performed by both Dr. \*1042 Deriso and in the BiOp. *Id.* at 79-80. Dr. Newman never suggested that an analysis utilizing raw salvage numbers (i.e., not adjusted for relative population size) is scientifically appropriate. This is not just a scientific dispute among experts, particularly in view of FWS’s concession in the BiOp.

c. Dr. Deriso admitted that he is not a delta smelt biologist, 4/6/10 Tr. 125, and that his analysis does not account for a number of potentially confounding factors, such as: the large amount of pumping-related mortality that is not measured by salvage, *id.* at 89; 116, pumping-related changes to delta smelt habitat, *id.* at 116, 140; pumping-related impacts on food supply, *id.* at 143; pumping-related impacts of spatial confinement of delta smelt to the Sacramento River, *id.* at 144-45; whether the death of some individuals such as fecund females may have a disproportionate impact on the population (the so-called “big mama” hypothesis) *id.* at 116; and whether the relationship between OMR flows and population abundance could change depending on population size, *id.* at 146.

d. Nor did Dr. Deriso’s analysis distinguish between years pre-dating or post-dating the POD, though he acknowledged that there is evidence of drastic changes in the estuary during that period. *Id.* at 123-24, 165. Reputable scientists in the field, including Drs. Peter Moyle and Bill Bennett, have opined that statistical “correlations [in the Delta] seem to be losing some of their former predictive value in recent years for some desirable species (Kimmerer et al.2009). This, in part, may be due to

... the extremely low abundance of desirable fishes, which may not be tracked as effectively by the traditional monitoring programs.” *Id.* at 119-20.

e. In the absence of reliable population estimates for delta smelt, Dr. Deriso utilized the FMWT index as a proxy for population when conducting his analysis of the population-level effects of salvage on adult delta smelt. However, Dr. Newman noted that there are several biases in the FMWT data, particularly selection bias, such that he would not rely purely on FMWT data “when it comes to analyzing salvage.” 4/5/10 Tr. 118.

e. In addition, Dr. Deriso’s analysis accounts in only a very limited way for spatial distribution (by excluding years with low turbidity from the analysis). Spatial distribution reflects the increased vulnerability of delta smelt to entrainment as they move closer to the pumps. 4/5/10 Tr. 80-82. In contrast, Components 1 and 2 of the BiOp account for spatial distribution to a much greater extent by allowing for modification of the level of OMR flows based on the location of delta smelt in the estuary. 4/7/10 Tr. 55-56, 69-71. Dr. Deriso’s analysis looks solely at the relationship between population-weighted salvage and OMR flows, excluding all other factors and considerations.

68. Nevertheless, even assuming all of these critiques of Dr. Deriso’s opinion are valid, they do nothing to justify the BiOp’s election to base its flow prescriptions on an analysis that uses raw salvage numbers. Even if Dr. Deriso’s “first cut” needs refinement to address these critiques, the BiOp’s analysis in Figure B-13 does not account for any of the issues on which Federal Defendants criticize Dr. Deriso’s analysis.

69. Federal Defendants note that Dr. Deriso presented his conclusions and analysis regarding the BiOp to the National Research Council of the National Academy of Sciences panel that peer-reviewed the BiOp. 4/2/10 Tr. 193; 4/6/10 Tr. 137. After reviewing the information presented by \*1043 Dr. Deriso, that panel explicitly disagreed with his conclusion that FWS’s analysis in the BiOp was not based on the best available science or one that a “reasonable biologist” would perform. Instead, the NRC Panel confirmed the analysis performed by FWS and its biologists, stating that:

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Although there are scientifically based arguments that raise legitimate questions about this action, the committee concludes that until better monitoring data and comprehensive life cycle models are available, it is scientifically reasonable to conclude that high negative OMR flows in winter probably adversely affect smelt populations. Thus the concept of reducing OMR and negative flows to reduce mortality of smelt at the SWP and CVP facilities is scientifically justified.

4/2/10 Tr. 194. The NRC analysis justifies its conclusion by recognizing better monitoring is not available, a comprehensive life cycle model does not exist, and that high negative OMR flows in winter “probably” adversely affect smelt populations.

70. The NRC's equivocal conclusion is in no way inconsistent with a finding that the BiOp failed to utilize the best available scientific methods by relying on a quantitative analysis using raw salvage to select the upper ceiling for negative OMR flows under Component 2. The Federal Defendants have not told the whole NRC Panel story. The NRC Panel expressly found that “there is *substantial uncertainty* regarding the amount of flow that should trigger a reduction in exports,” (emphasis added) and declined to decide whether alternative RPAs would “provide equal or greater protections for the species while requiring less disruptions of Delta water diversions,” concluding that the panel had received insufficient documentation on such alternatives. *Id.* at 200-01. Having failed to perform the required NEPA analysis, it is certain that Federal Defendants could not and did not take the requisite hard look at RPA alternatives.

71. Federal Defendants argue that the district court previously heard and rejected similar statistical analysis of fish population dynamics presented by Mr. B.J. Miller during the 2007 interim remedy hearing.

a. Mr. Miller “concluded that there was no statistical significance in the relationship between Delta smelt abundance and salvage and export operations in the pumps.” 4/6/10 Tr. 114. Another of Plaintiffs' witnesses in that proceeding, Dr. Charles Hanson, then explained that even if Mr. Miller's statistical analyses were correct and “reflect the

low significance of that salvage mortality to the population,” it did not suggest that regulatory action to minimize salvage at the pumps was not justified:

On the other side, Your Honor, the fact that we are salvaging Delta smelt represents a source of mortality to this population. And one of the approaches that's being made, given the low population abundance, is to identify those sources of mortality that we know of and to try and reduce those. My feeling is that we have such a complex estuary with so many interacting variables that change from year to year and within years, that it's difficult to rely solely on statistical analyses. I think we're at a point where we need to say do we have a substantial source of mortality and is there something we can do to help reduce that.

4/6/10 Tr. 114-15.

b. Plaintiffs' expert, Dr. Hilborn, expressed similar opinions during the most recent evidentiary hearings, acknowledging that, while he criticized the BiOp for lacking “a basis for population level effects of the proposed actions ... it's \*1044 pretty clear that there are viability concerns about Delta smelt.” 4/5/10 Tr. 224. Dr. Hilborn also acknowledged “it's very clear that large negative flows have an impact on the number of fish that are impinged and entrained.” *Id.* at 228. He did not quantify what he meant by “large negative flows.” Dr. Hilborn agrees that there is no doubt that the population size of delta smelt is currently at an historic low and that entrainment at project facilities results in direct mortality. *Id.* at 249-50. Dr. Hilborn explained that he does not deny that a long-term relationship between population growth rate and salvage may exist, only that he has not seen “any evidence of that in any of the analysis I've seen so far.” *Id.* at 228. Dr. Hilborn acknowledged that he “couldn't exclude the possibility” that a future salvage event could eliminate 100% of the population, even if there was no relationship between the amount of delta smelt salvaged and long-term population dynamics. *Id.* at 229.

c. Assuming, arguendo, the “possibility” cannot be “exclude[d]” that a future salvage event could eliminate 100% of the population, FWS did not justify its selection of -5,000 cfs on the basis of that ceiling's ability to prevent such a catastrophic sal-

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vage event. Faced with express concerns from inside and outside the agency about drawing conclusions from analyses using raw salvage, FWS completely failed to explain why it nonetheless did so. None of the post-hoc rationalizations offered by Federal Defendants, e.g. the “big mama” hypothesis, was mentioned in the BiOp as bases for selecting -5,000 cfs as the ceiling for negative OMR flows.

72. FWS's reliance on analyses that utilize raw (as opposed to population-normalized) salvage data is an undeniable failure to use the best available scientific methodology.

*b. Other Data Supporting the General Conclusion that Negative OMR flows Jeopardize the Smelt.*

73. There is far more dispute over the sufficiency of evidence supporting the BiOp's general conclusion that the negative OMR flows predicted to take place under planned Project operations will jeopardize the smelt (referred to in this subsection as the “jeopardy conclusion”).

*(1) Sporadically Significant Take.*

74. One of the key rationales for the jeopardy conclusion is the assertion that entrainment has a “sporadically significant” effect on smelt abundance. BiOp at 210. This assertion was based on the estimates of proportional entrainment in Kimmerer 2008. BiOp at 210; Fed. Gov't Smelt Ex. 38. Kimmerer 2008 states that:

Delta smelt may suffer substantial losses to export pumping both as pre-spawning adults and as larvae and early juveniles. In contrast to the situation for salmon, pre-salvage mortality has been constrained in the calculations for adult Delta smelt, and its effects eliminated from the calculations for larval/juvenile Delta smelt. Combining the results for both life stages, losses may be on the order of zero to 40 percent of the population throughout winter and spring.

4/7/10 Tr. 42-43; AR 018877.

75. Dr. Grimaldo confirmed that the Kimmerer (2008) and Kimmerer and Nobriga (2008) studies represented the “best available science” when the BiOp was prepared. 4/7/10 Tr. 63-64. The BiOp cites Kimmerer (2008) (and other peer-reviewed studies)

for the propositions that entrainment can affect the abundance of delta smelt in certain years; may prevent recovery when habitat conditions are suitable; and that high entrainment of adults in the winter appears to have played a role in the \*1045 decline of delta smelt in the POD years. BiOp at 158-59.

76. Dr. Deriso questions whether Kimmerer (2008) should be interpreted as standing for the proposition that entrainment mortality can kill a substantial portion of the population in some years. For example, he testified that the Kimmerer (2008) article relied on a number of assumptions to calculate the percentage entrainment figures incorporated into the BiOp, including the assumption that a proportional relationship exists between OMR flow levels and entrainment. 4/6/10 Tr. 131:12-16; Fed. Gov't Smelt Ex. 29 at 19; Fed. Gov't Smelt Ex. 38 at 018875-018876. Because the Kimmerer (2008) article began with this assumption, Dr. Deriso opined that it could not reasonably be used by FWS as evidence that a proportional relationship exists between OMR flow level and smelt entrainment. Fed. Gov't Smelt Ex. 29 at 19.

77. But, the BiOp did not rely on Kimmerer (2008) for this purpose. Dr. Grimaldo explained that “what the Kimmerer 2008 paper actually showed was that there was a population response [to entrainment] *within life stages*.” 4/7/10 Tr. 98.<sup>FN5</sup> Dr. Newman explained that this information is “certainly pertinent to understanding what's happening with the population.” 4/5/10 Tr. 135-136.

<sup>FN5</sup>. Kimmerer (2008) acknowledges that “... despite substantial variability in export flow in years since 1982, no effect of export flow on subsequent midwater trawl abundance is evident,” but refuses to “dismiss the rather large proportional losses of delta smelt that occur in some years; rather, it suggests that these losses have effects that are episodic and therefore their effects should be calculated rather than inferred from correlation analyses.” Fed. Gov't Smelt 38 at 25 (AR 018878). Dr. Quinn opined that “evidence should have been presented in the BiOp to demonstrate such effects, based on some calculation.” Doc. 633 at 2. For example, he asks: “In which years were there large losses that can be directly attrib-

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uted to the pumping operations, and what were the effects on subsequent recruitment? Because the smelt are largely annual fish, a catastrophe in a single year could put them at great risk of extinction and two bad years in a row could accomplish it. The risk inherent in the statistical and ecological uncertainty is borne heavily by the species but there still should be some evidence in the record to reveal these effects.” *Id.* It is not clear whether the BiOp relies on Kimmerer 2008 as evidence of these effects or simply as evidence that these effects may be significant.

78. Dr. Newman, who did not participate in the preparation of the BiOp, agreed that FWS's conclusion in the BiOp that entrainment affects subsequent year abundance of Delta smelt even sporadically is supported by generally accepted scientific standards. 4/5/10 Tr. 89-90. It is undisputed that very large salvage events can and have occurred at OMR flows of less than -5,000 cfs. In May and June of 1999 alone, 58,929 and 73,368 delta smelt, respectively, were salvaged at the Project export facilities. 4/6/10 Tr. 111. Average OMR flows during those months were -1,062 cfs and -3,814 cfs, respectively. *Id.* at 112. While Dr. Deriso testified that the significance of such an event depends on the size of the population, he also could not state whether the current population was large enough to survive similar salvage events, or whether such an event would jeopardize the continued existence of the smelt. *Id.* Dr. Hanson, another of Plaintiffs' expert fish biologist witnesses, testified in 2007 that salvage of 1,300-1,400 delta smelt would be “a very high level of salvage” “under the current population levels.” *Id.* at 113. Delta smelt abundance levels have further declined since Dr. Hanson made that statement. *Id.*

79. It was not unreasonable for FWS to conclude that salvage events may be “sporadically significant.”

**\*1046 (2) Dr. Bennett's Work.**

**(a) Impact of VAMP on Population Dynamics.**

80. Dr. Bennett's unpublished research “demonstrated that the number of larvae that survived to the fall is related to when they hatch in the spring .... [and] that larvae that hatched during the VAMP ... protective period[ ] were the ones that survived to the fall in the period that he examined.” 4/7/10 Tr. 93.

**81. The BiOp concluded:**

Based on Bennett's unpublished analysis, reduced spring exports resulting from VAMP have selectively enhanced the survival of delta smelt larvae spawned in the Central Delta that emerge during VAMP by reducing their entrainment. Initial otolith studies by Bennett's lab suggest that these spring-spawned fish dominate subsequent recruitment to adult life stages. By contrast, delta smelt spawned prior to and after the VAMP have been poorly-represented in the adult stock in recent years. The data suggests that the differential fate of early, middle and late cohorts affects sizes of delta smelt in fall because the later cohorts have a shorter growing season. *These findings suggest that direct entrainment of larvae and juvenile delta smelt during the spring are relevant to population dynamics.*

BiOp at 170 (emphasis added). Nothing in the record suggests this conclusion was unreasonable.

**(b) Big Mama Hypothesis.**

82. Federal Defendants and Defendant Intervenor also suggest that Dr. Bennett's work provided “evidence” to support the “big mama” hypothesis that Project operations may affect delta smelt abundance by entraining the most fecund individuals in the population, thereby creating a disproportionate impact on the reproductive potential and growth rate of the population.

83. However, the BiOp does not suggest Bennett's work provides *evidence* of this hypothesis; rather, the BiOp consistently indicates that the “big mama” hypothesis is just that—a hypothesis:

Another possible contributing driver of reduced delta smelt survival, health, fecundity, and resilience that occurs during winter is the “Big Mama Hypothesis” (Bill Bennett, UC Davis, pers. comm. and various oral presentations). As a result of his synthesis of a variety of studies, Bennett proposed that the largest delta smelt (whether the fastest growing age-1 fish or fish that manage to spawn at age-2) *could* have a large influence on population trends. Delta smelt larvae spawned in the South Delta have high risk of entrainment under most hydrologic conditions

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(Kimmerer 2008), but water temperatures often warm earlier in the South Delta than the Sacramento River (Nobriga and Herbold 2008). Thus, delta smelt spawning often starts and ends earlier in the Central and South Delta than elsewhere. This differential warming *may* contribute to the “Big Mama Hypothesis” by causing the earliest ripening females to spawn disproportionately in the South Delta, putting their offspring at high risk of entrainment. Although water diversion strategies have been changed to better protect the ‘average’ larva, the resilience historically provided by variable spawn timing *may be* reduced by water diversions and other factors that covary with Delta inflows and outflows.

BiOp at 158 (emphasis added). This hypothesis has not been proved.

**\*1047** (3) *Consideration of Life Stage and Geographic Distribution.*

84. The BiOp considers the life stage of delta smelt and where the population is located in the estuary, to help assess entrainment risk. Dr. Grimaldo explained:

[I]n the fall [and] winter, we have very low entrainment risk. But once the first flush events happen, beginning sometime in mid December, Delta smelt often migrate upstream. So they're vulnerable at this part of the life stage. After they migrate upstream, they stage for a little bit. And they're vulnerable to entrainment during the staging period. And then after the staging period, they spawn. And their progeny are vulnerable to entrainment at this period.

So there's vulnerability to different life stages as and, in general, as they become distributed closer to the central and south Delta central and south Delta, their entrainment risk goes up.

4/7/10 Tr. 50-51. The RPA takes into account these spatial and life stage factors by breaking actions into different components over different periods of time. *Id.* at 64-65.

85. Mr. Feyrer and Dr. Grimaldo testified that the export pumps affect the geographic distribution of delta smelt, and that preventing the fish from coming near the pumps reduces the risk of entraining those

fish. 4/2/10 Tr. 180; 4/7/10 Tr. 64. Larval and juvenile delta smelt, in particular, are “neutrally buoyant” and thus follow the flow in the Delta in a manner similar to particles. 4/7/10 Tr. 54-55. Particle-tracking modeling shows that many of the particles are “lost” to the pumps when export-inflow ratios are increased. *Id.* at 59-60. Kimmerer and Nobriga (2008), relied on in the BiOp, asserts that these studies “suggest a direct link between the position of the smelt population as determined by outflow and losses as determined by export flow” and “may be enough to recommend strong protective measures for Delta smelt in spring (March-May) of low outflow years when they are highly vulnerable to export losses.” *Id.* at 60-62. Non-export factors influence entrainment too, “such as river inflows, the position of X2 and where the fish are distributed.” *Id.* However, as Mr. Feyrer testified, “essentially the closer [the fish] are, the more vulnerable [they] will be” to the effects of entrainment. <sup>FN6</sup> *Id.*

<sup>FN6</sup>. Entrainment includes more than just salvage measured at the pumps. As Mr. Feyrer explained, salvage is a small subset of entrainment: “Salvage is essentially the fish that are observed at the ... salvage facilities. Those are the facilities that are located at both the state and federal export operation facilities. And those facilities are designed to essentially filter the fish out of the water before they are entrained into the pumps. And then they're released back into the estuary. And so those are the fish that you actually observe in salvage. However, entrainment refers to the fish that are not observed plus those fish that are observed.” 4/2/10 Tr. 180-81. Fish that are not observed include those that suffer from pre-screen mortality at Clifton Court Forebay, *id.* at 182, and those that are not detected due to louver inefficiency. Pumping pulls fish into the Forebay, increasing their exposure to these sources of mortality. *Id.* at 183.

*c. Life Cycle Analysis.*

86. Studies cited in the BiOp failed to demonstrate that water exports affect the delta smelt population growth rate. Kimmerer (2008), for example, noted a “lack of evidence for population-level effects” of the water projects and stated that “no effect of export flow on subsequent midwater trawl is evi-

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dent.” AR 018878, 018855; MWD Ex. 600 at 53; MWD Ex. 600 at 28. Bennett (2005) found that “it is unlikely that losses of young fish to the export facilities consistently reflect a direct impact on recruitment success later in the year.” AR 017004; MWD Ex. 607; SLDMWA Ex. 240.

\*1048 87. All experts agree that application of a life-cycle model <sup>FN7</sup> is accepted method for evaluating the effects of an action upon a population's growth rate.

<sup>FN7</sup>. The experts use the term “population dynamics model,” “life history model,” and “life cycle model” interchangeably. *See, e.g.*, 4/2 Tr. 255; 4/6 Tr. 41.

a. The Delta Smelt Action Evaluation Team recognized that such a model should be developed and utilized. MWD Ex. 633 at 5, 9, 10, 11.

b. Dr. Deriso testified that a population growth rate analysis is the method by which fisheries biologists normally evaluate the impact of a stressor on a population. 4/6/10 Tr. 38:11-18.

c. Dr. Hilborn similarly testified that life-cycle models are the accepted method in population dynamics to evaluate anthropogenic effects on the probability of growth or decline of a species. 4/5/10 Tr. 154:16-24. Dr. Hilborn testified that development of such a model is “standard operating procedure” for fisheries management agencies to evaluate human impacts on fish species. 4/5/10 Tr. 155:20-25.

d. FWS's expert, Dr. Newman, stated in his declaration that he “agreed with the utility of life history models for assessing population level effects of SWP/CVP operations.” Fed. Gov't Smelt Ex. 17 at 8.

e. Dr. Newman said he would have developed a life-cycle model for the BiOp. 4/5/10 Tr. 107:21-108:5. Dr. Newman stated the methodology employed in the BiOp was “quite a different way of doing things” from the statistical analysis he was “familiar with” and “comfortable with.” 4/5/10 Tr. 107:21-108:5.

f. Federal Defendants' expert, Mr. Feyrer, testified that, once developed, a life-cycle model would be the best available science to evaluate the population-level impacts of the water projects on the delta smelt. 4/2/10 Tr. 253:4-10.

g. According to Mr. Feyrer, use of a life-cycle modeling methodology in the BiOp would have reduced the uncertainty in the RPAs. 4/2/10 Tr. 258:22-259:8.

88. How long it would have taken FWS to develop an appropriate life cycle model is a matter of considerable debate.

a. Life-cycle modeling is an analytical technique that has been known and available to scientists for years. 4/5/10 Tr. 109:19-110:3. Numerous textbooks and reference articles explain how to develop a life-cycle model, which are a standard tool used by fisheries scientists to evaluate population-level impacts. 4/2/10 Tr. 254:23-255:14. Basic growth rate models such as the Ricker model and the Beverton-Holt model were developed in the 1950s. 4/6/10 Tr. 41:22-42:4; 49:16-22.

b. Dr. Deriso testified that sufficient data existed at the time of the creation of the BiOp to enable FWS to perform a quantitative life-cycle modeling analysis. 4/6/10 Tr. 46:16-47:16.

c. Dr. Deriso testified that a basic quantitative life-cycle modeling analysis could be performed in less than an hour, while a more complicated modeling effort could be completed in a few weeks. 4/6/10 Tr. 43:2-7.

d. Mr. Feyrer testified that FWS could have completed a life-cycle modeling analysis within 18 months. 4/2/10 Tr. 263:15-24.

e. In a 2005 research article Dr. Bennett employed a life-cycle model to evaluate a number of impacts on the delta smelt. 4/2/10 Tr. 46:16-47:16.

f. Dr. Hilborn testified that a life-cycle modeling effort could have been performed for the delta smelt within a matter of months. 4/5/10 Tr. 175:5-21. \*1049 He further testified that even an incomplete life-cycle modeling analysis, such as the one

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found in Bennett (2005), would be superior to simply relying on professional or expert opinion without use of any such model. 4/5/10 Tr. 212:23-213:6. However, Dr. Hilborn admitted that when he and Dr. Maunder actually endeavored to build a quantitative population dynamics model for delta smelt over 18 months ago, they abandoned that particular modeling effort as too complicated and time-consuming. *Id.* at 217-18.

g. Dr. Punt stated “[i]t is surprising that a population dynamics model was not developed for delta smelt for the BiOp.... The model developed by Bennett could have been extended to more fully account for the biology of delta smelt and fitted to data to assess the population-level effects of impact of the project.” 4/6/10 Tr. 44:16-21; Doc. 633, Ex. A, at 3.

89. Yet, a quantitative population dynamics model for delta smelt is “not something that you go to the store and just buy [like] a piece of equipment,” but rather would consist of a large amount of formulas. 4/2/10 Tr. 254; 4/5/10 Tr. 48 (Dr. Newman concurring that “there’s not off-the-shelf software to build such models”). Dr. Newman testified that previous efforts to build such models in which he has been involved have taken two to three years, 4/5/10 Tr. 50, and have involved numerous people because you need expertise in biology, statistics, and modeling. *Id.* at 131. Mr. Feyrer stated that “the construction of a full blown high quality life cycle model is no simple task.” 4/2/10 Tr. 255, 258.

90. Mr. Feyrer also pointed out the importance of constructing an appropriate and well-calibrated model: “even for individuals with the amazing skills of [Drs. Maunder, Deriso and Hilborn], it still takes a lot of time to develop those to where you have the confidence in them so that you can actually apply them in a situation where, you know, there’s obviously a lot at stake here. You don’t want to apply something prematurely without really understanding how well it works.” *Id.* at 258. Dr. Deriso, in contrast, applied a generic “textbook” version of a life history model in the analysis he presented to the Court, without modifying it to apply specifically to delta smelt biology and characteristics. 4/6/10 Tr. 42. Significant disagreement exists among competent experts as to what constitutes a reliable quantitative population dynamics model for delta smelt.

91. Federal Defendants were aware of the value of a life-cycle model. At a March 8, 2007 meeting regarding the OCAP ESA Re-consultation, attended by a number of FWS employees, the importance of using a life cycle model was recognized and the progress to date was inquired into. 4/7/10 Tr. 183:9-188:4; SWC Ex. 960. Likewise, during the Delta Smelt Action Evaluation Team meeting on August 8, 2008, the Team recognized that population models for delta smelt already had been developed, and that it was possible to use those models as a starting point for quantitative analyses with appropriate assumptions added as bounds to the analysis. 4/7/10 Tr. 188:9-190:22.

92. Nevertheless, it is undisputed that, despite over three years of controversy regarding the species, no quantitative life cycle model adapted to the delta smelt was available to or used by FWS at the time the BiOp was issued. A quantitative population dynamics model for delta smelt does not currently exist, although there are several efforts underway to develop one. 4/2/10 Tr. 189; 4/5/10 Tr. 44. Researchers from a number of universities, including Drs. Wim Kimmerer, Bill Bennett, Kenny Rose and Steve Monismith, have been working on developing such a model for a \*1050 number of years. *Id.* at 189-90; 4/5/10 Tr. 46. Dr. Mark Maunder has also been working on such a model for delta smelt since at least March 2008, with the assistance of Dr. Hilborn and Dr. Deriso. *Id.* at 258; 4/5/10 Tr. 47. Dr. Newman, who has previously developed three quantitative life history models, is currently working with the National Center for Ecological Analysis and Synthesis (“NCEAS”) to develop one for delta smelt, an effort that has been underway since October 2007. 4/5/10 Tr. 44-46.

93. No party who participated in the preparation of the BA or commented on the public review drafts of the BiOp submitted a quantitative life cycle model or the results of such an analysis using a life cycle model for delta smelt to FWS during the consultation. 4/5/10 Tr. 16-18.

94. It is notable that FWS did make use of the relatively simple and limited life-cycle model described by Dr. Bennett in his 2005 paper. 4/2/10 Tr. 256-57. It utilized that existing model by conducting the effects analysis in the BiOp according to a similar conceptual life-cycle model. *Id.* at 258. The agency

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then conducted analyses on specific components of those life stages that would be affected by the proposed Project operations. *Id.* Dr. Hilborn asserts that FWS erred by not using the Bennett model to justify the export limitations in the RPA, 4/5/10 Tr. 241, but the Bennett 2005 paper and Dr. Bennett himself cautioned that the life-cycle model it presented is “premature for management purposes.” *Id.* at 18, 115, 240-41.

95. In sum, although all agree that a quantitative life-cycle model would help FWS evaluate impacts on delta smelt, FWS had not developed an appropriate model, and no such model was available for FWS's use (or otherwise presented to FWS) prior to the issuance of the BiOp.

*d. Incidental Take Statement.*

96. Plaintiffs included proposed findings of fact concerning FWS's formulation of the Incidental Take Statement (“ITS”). However, at the evidentiary hearing, Plaintiffs abandoned their request to enjoin implementation of the ITS. 4/7/10 Tr. 243-44 (“Plaintiffs do not seek modification of the incidental take limit at this time. Even though the current low ITS limits are not supported by the data and application of quantitative population dynamics analysis, that very conservative limit, Your Honor, plaintiffs believe will serve as a back stop that will provide an additional level of assurance to the Court that during the component two period, which ends in June, the survival of the smelt will not be jeopardized by project operations.”).

*e. Critical Habitat.*

97. Federal Defendants and Defendant Intervenor maintain, in the alternative, that negative OMR flows adversely modify critical habitat and Component 2 can be upheld because it addresses this adverse modification. 4/7/10 Tr. 272:8-273:3; 4/6/10 Tr. 93:2-6; 4/5/10 Tr. 225:18-226:22.

98. However, the specific quantitative criteria established for RPA Component 2 are not derived from or justified by any independent analysis of adverse modification of delta smelt critical habitat. BiOp at 344-68.

99. Discussion of habitat in the justifications for RPA Components 2 defines habitat solely in terms of entrainment risk. BiOp at 344-368. The only quanti-

tative analysis of entrainment risk is found in Figures B-13 and B-14 of the BiOp. BiOp at 348, 350.

*f. Indirect Harm.*

100. Federal Defendants claim that Component 2 also protects against indirect harm. However, the quantitative analysis used to derive the flow levels does not \*1051 mention indirect harm as a basis for the flow restrictions imposed.

*g. The Role of RPA Component 2 in Avoiding Jeopardy to the Species and Adverse Modification of Critical Habitat.*

101. All of the experts qualified in delta smelt biology concurred that enjoining parts or all of Component 2 would cause jeopardy or adverse impacts to delta smelt and designated critical habitat.

102. Dr. Grimaldo explained that entrainment risk is particularly high from March to May because delta smelt larvae and juveniles are most likely to behave like neutrally buoyant particles during this time period. 4/7/10 Tr. 68.

103. Ms. Goude testified that the Projects exert a direct entrainment effect on delta smelt, as well as indirect impacts upon the species' food supply, risk of predation, and exposure to contaminants and other stressors, and affect critical habitat by changing the amount and location of habitat in winter, spring and fall. *Id.* at 150-51. In her opinion, enjoining Action 3 of the RPA would result in irreparable harm to the delta smelt due to very low abundance levels and the risk of a “huge” entrainment event causing “catastrophic events.” *Id.* at 169-70.

104. However, none of these experts offered any quantitative or qualitative analysis, apart from that discussed above, which utilized raw salvage data, to specifically justify the imposition of a -5,000 cfs ceiling on negative OMR flows.

*h. Alternative Proposal to Limit negative OMR Flow to -5,600 cfs.*

105. Plaintiffs suggest imposition of a -5,600 ceiling on OMR flows. This is based entirely on Dr. Deriso's analysis of population-indexed salvage rates versus negative OMR flows. Although Dr. Deriso's analysis corrects for the fundamental error of relying on raw salvage figures, given the large number of variables *not* accounted for in Dr. Deriso's analysis, it

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is unclear whether the -5,600 break-point he suggests is any more or less appropriate as a ceiling than the -5,000 figure utilized in the BiOp.

106. Mr. Feyrer opined that operating the Project pumps to meet OMR flows no less negative than -5,600 cfs, the alternative OMR ceiling proposed by Plaintiffs, during the spring would *not* avoid jeopardy to the delta smelt or adverse modification of its critical habitat. 4/2/10 Tr. 208.

107. Regardless of the appropriate upper limit for negative OMR flows, RPA Component 2 defines a range of OMR flows within which the Projects may operate during designated time periods. This range of flows “provides flexibility in [ ] water operations [and] the ability to be protective when their conditions are not favorable-or when entrainment risk increases.... So it maximizes protection for the species while providing flexibility for water operations.” 4/7/10 Tr. 66-67. According to Dr. Grimaldo, operating to a “unitary” flow, as recommended by Plaintiffs, “removes your flexibility from managing that risk”:

So there may be times when the fish become distributed in the south Delta or the central Delta. And perhaps a lot of them, like we saw in April 2002 and April 2003 were large number of the larvae were in the central and south Delta. If you were at a fixed number, that your risk would be high and you would have substantial losses, which were demonstrated in Kimmerer 2008 during that time period.

*Id.* at 67.

108. Both the BiOp and subsequent peer reviews have acknowledged that the specific OMR flow triggers and the implementation of the OMR-flow related requirements\*1052 of the RPA “need[ ] to be accompanied by careful monitoring, adaptive management and additional analyses that permit regular review and adjustment of strategies as knowledge improves.” 4/2/10 Tr. 195; BiOp at 279 (“[t]he specific flow requirements, action triggers and monitoring stations prescribed in the RPA will be continuously monitored and evaluated consistent with the adaptive process. As new information becomes available, these action triggers may be modified without necessarily requiring re-consultation on the overall pro-

posed action.”).

109. Although the record shows that FWS’s -5,000 OMR ceiling is not based on the best available science, the record does not contain sufficient information to conclude that the imposition of Plaintiff’s suggested -5,600 OMR ceiling would be sufficiently protective of the smelt, particularly in light of the fact that Plaintiffs do not propose any flexibility in the management regime that would permit greater restrictions if a large salvage event was approaching or ongoing.

110. Providing flexibility to permit adaptive management for delta smelt is justified.

#### *D. Irreparable Harm.*

111. The record evidence has established a variety of adverse impacts to humans and the human environment from reduced CVP and SWP deliveries, including irretrievable resource losses (permanent crops, fallowed lands, destruction of family and entity farming businesses); social disruption and dislocation; as well as environmental harms caused by, among other things, increased groundwater consumption and overdraft, and possible air quality reduction.

#### *(1) Water Supply Impacts.*

112. Any lost pumping capacity directly attributable to the 2008 Smelt BiOp will contribute to and exacerbate the currently catastrophic situation faced by Plaintiffs, whose farms, businesses, water service areas, and impacted cities and counties, are dependent, some exclusively, upon CVP and/or SWP water deliveries.

113. Every acre-foot of pumping foregone during critical time periods is an acre-foot that does not reach the San Luis Reservoir where it can be stored for future delivery to users during times of peak demand in the water year.

114. It is undisputed that, in the three water years prior to the 2009-2010 water year, California has experienced three consecutive years of drought conditions. Gov’t Salmon Ex. 5 at (internal) Exhibit 1 at 18. This influences the amount of run-off forecasted for 2010 and is indicative of why reservoir storages were at a low state entering the 2009-2010 water year. 4/1/10 Tr. 208:7-15. Hydrologic conditions are not within the control of the parties and have materi-

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ally contributed to water service reductions to contractors.

115. It is also undisputed that other, non-project factors, such as tides, wind events, storm surges, San Joaquin River flows, Contra Costa Water District operations, and diversions by in-Delta water users effect how Reclamation must operate the project to meet flow targets. *See id.* at 202:12-204:1.

116. The projects are subject to export reductions required to protect species listed under the California Endangered Species Act, including longfin smelt, delta smelt, winter-run Chinook salmon, and spring-run Chinook salmon, which subject the water project operators to controls under state law that are similar, and, in some cases, identical to those contained in the 2008 Smelt BiOp and the National Marine Fisheries Service's ("NMFS") June 4, 2009 Biological Opinion ("2009 Salmonid BiOp") concerning various ESA-listed\*1053 anadromous and oceanic species. *See id.* at Tr. 212:4-213:8. In the absence of the BiOps' RPAs, those protections are argued to have likely limited export pumping to levels below those allowable under State Water Resources Control Board Decision 1641 ("D-1641"), which also limits Project pumping at certain times of the year. *See, e.g.,* SWC Ex. 938 (DWR's 3/30/10 allocation announcement considered several "SWP operational constraints" including "the incidental take permit for longfin smelt").

117. Plaintiffs' estimates of water losses do not account for or otherwise offset losses attributable to proposed remedies in the consolidated Delta Smelt and Salmon cases. *See* 4/7/10 Tr. 17:10-20:14.

118. The quantity of exportable water has been reduced by the implementation of the Salmonid and Smelt BiOp's RPAs. *Id.* From January 20 through March 24, 2010, Mr. Erlewine testified that potential and actual exports were diminished by 522,561 acre feet ("AF"), of which a 433,000 AF loss was attributable to the SWP and a 89,000 AF loss was attributable to the CVP. 4/6/10 Tr. 185:16-19; SWC Demonstrative Ex. 903.

119. DWR made its initial water supply allocation announcement on November 30, 2009, allocating 5% of Table A contracted amounts for SWP water contractors. 4/6/10 Tr. 240:16-22; SWC Ex. 923, Ex.

B. As of March 30, 2010, DWR increased the SWP allocation for 2010 to 20%. 4/6/10 Tr. 189:15-17; SWC Ex. 938; 4/1/10 Tr. 249:22-25. On April 23, 2010, DWR again increased its allocation of SWP deliveries to 30%. *See* Doc. 323-2 (DWR Press Release).

120. Reclamation announced its initial allocation of CVP water on February 26, 2010. Fed. Gov't Salmon Ex. 5 (Third Milligan Decl.) at 11. Under the 90% exceedance forecast, Reclamation allocated CVP agricultural users 5% of their contract amounts, and CVP municipal and industrial ("M & I") contractors 55% of their contract amounts. *Id.* at 12. Under the 50% exceedance forecast, north-of-Delta agricultural and M & I contractors were allocated 100% of their contract amounts, while south-of-Delta agricultural contractors were allocated 30% and M & I contractors 75%. *Id.*

121. CVP water users faced similar reductions to their individual allocations. Farmers on the west side of the San Joaquin Valley have received reduced CVP water supply allocations in the 2007-2008, 2008-2009, and 2009-2010 water years, and face similar reductions in 2010-2011. SLDMWA Ex. 153 at 3; SLDMWA Ex. 154 at 4; SLDMWA Ex. 156 at 4. In 2007-2008, Reclamation allocated to Westlands 40% of its contract supply. In 2008-2009, that allocation was 10%. SLDMWA Ex. 155 at 8. For the 2009-2010 water year, Westlands was advised the initial allocation was zero percent. SLDMWA Ex. 155 at 9.

122. On March 16, 2010, Reclamation raised the allocation for south-of-Delta agricultural users to 25% under a 90% forecast and 30% under a 50% forecast. 4/1/10 Tr. 210:14-22; Fed. Gov't Salmon Exh. 13.

123. These incremental increases do not alter the fact that water deliveries will likely increase further if the two RPAs are enjoined. 4/1/10 Tr. 213:14-20 (acknowledging that deliveries would increase by 5%-10% if the RPAs were enjoined).

124. The quantity of water lost through pumping reductions translates directly into water losses for urban and agricultural water users. In the SWP service area, one acre-foot of water serves about five to seven people for one year. 4/6/10 Tr. 186:25-187:1-3. An SWP loss of 433,000 AF, if available to urban

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users, would have supplied approximately 2.6 million people for one year. 4/6/10 Tr. 187:8-11. Seventy-five\*1054 to eighty-five percent of SWP supply is provided for urban uses, with the remainder provided to agricultural users. 4/6/10 Tr. 187:15-17. The Metropolitan Water District of Southern California alone serves approximately 20 million urban users.

125. Water loss for agricultural users results in reduction in the number of acres that may be sustained with actual water supply. Water duty is the amount of water that a crop needs per acre for a growing season. 4/6/10 Tr. 187:21-22. DWR information indicates that for the SWP service area, the water duty is approximately three AF per acre. 4/6/10 Tr. 187:22-25. If 433,000 AF were withheld from almond crops, for example, almond production would be reduced by approximately 140,000 acres. 4/6/10 Tr. 188:1-4.

126. Reduced CVP and SWP water supply allocations have increased the cost of supplemental water. Farmers have been forced to purchase supplemental water at drastically increased cost. SLDMWA Ex. 154 at 7; SLDMWA Ex. 155 at 17; SLDMWA Ex. 156 at 6. Since 2007, the cost of securing supplemental water has more than tripled. SLDMWA Ex. 156 at 6; SLDMWA Ex. 154 at 7. As of January 2010, the cost for buying replacement water for transfer in a dry year is at least \$300 per acre foot, plus transportation costs. SLDMWA Ex. 157 at 12.

127. Increased water allocations may lessen this increased cost, and will mitigate anticipated harms from reduced water allocations. Farmers anticipate that increased water allocations would mitigate anticipated damage to crops in proportion to the amount of water received and prevent further layoffs of farm employees. SLDMWA Ex. 156 at 10.

128. In 2009, the Federal Defendants accounted for actions taken under the Delta smelt biological opinion as (b)(2) actions, pursuant to section 3406(b)(2) of the CVPIA. 4/1/10 Tr. 213:24-214:2. Federal Defendants have indicated their intent to follow the same accounting procedure for federal export reductions related to both BiOps in 2010, to the extent that (b)(2) assets are available at the time the action is taken. *Id.* at 214:3-7.

(2) *Other Resource Impacts Caused or Exacerbated*

*by the 2008 Smelt BiOp RPA Actions.*

129. Plaintiffs attribute a number of other human impacts to reductions in the water supply. There is considerable dispute among the parties regarding the extent to which the 2008 Smelt BiOp RPA is responsible for these other impacts. It is undisputed that the RPA is, at the very least, exacerbating the following impacts.

(1) *Permanent Crops.*

130. Reductions in the quantity of water supply deliveries have resulted in changes to farming practices, including an increased reliance on permanent crops. SLDMWA Ex. 154 at 6; SLDMWA Ex. 155 at 18, 22; SLDMWA Ex. 157 at 11.

131. Permanent crops place farmers at greater risk than row crops, as farmers cannot cut back on the water to permanent crops without destroying them. SLDMWA Ex. 154 at 6; SLDMWA Ex. 155 at 18, 22; SLDMWA Ex. 157 at 11.

(2) *Fallowed Lands.*

132. Because of reduced water forecasts and uncertainty regarding future water supply, farmers have fallowed hundreds and thousands of acres of fields. SLDMWA Ex. 155 at 10; SLDMWA Ex. 153 at 3; SLDMWA Ex. 156 at 5.

133. Fallowed lands and reduced water supply have caused the loss of thousands of acres of crops. Todd Allen, a third-generation farmer in Fresno County, was able to salvage and harvest only 40 acres of a wheat crop out of a total arable 616 \*1055 acres on his farm in 2009. SLDMWA Ex. 153 at 3.

134. For every 1,000 AF of water lost by the San Luis Plaintiffs' member agencies, approximately 400 acres of land may remain out of production. SLDMWA Ex. 157 at 13.

135. Fallowing fields also negatively impacts the air quality of the San Joaquin Valley by increasing dust and particulate matter. SLDMWA Ex. 155 at 20. Reduced air quality in turn impairs major transportation routes through the valley. SLDMWA Ex. 155 at 20.

(3) *Lack of Access to Credit.*

136. The more unreliable the water supply, the

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more difficult it is for farmers to secure necessary financing for their farming operations. SLDMWA Ex. 153 at 4; SLDMWA Ex. 154 at 13; SLDMWA Ex. 155 at 26; SLDMWA Ex. 156 at 7; SLDMWA Ex. 157 at 15. In some cases, lenders deny loan applications because of a lack of reliable water supply. SLDMWA Ex. 153 at 4; SLDMWA Ex. 154 at 13; SLDMWA Ex. 155 at 26; SLDMWA Ex. 156 at 7; SLDMWA Ex. 157 at 15. In others, lenders' concerns about availability to lands irrigated by federally-supplied water has required farmers to make a 50% down payment to secure any loans. SLDMWA Ex. 156 at 7.

(4) *Social Disruption and Dislocation.*

137. It is undisputed that farm employees and their families have faced devastating losses due to reductions in the available water supply. The impact on the farm economy from the combination of a three-year drought and diversion limitations relating to the delta smelt has already been severe. SLDMWA Ex. 157 at 14.

138. Lost water supply has decreased the number of productive agricultural acres, which has resulted in reductions in employee hours, salaries, and positions, devastating farm employees and their families. SLDMWA Ex. 154 at 11; SLDMWA Ex. 156 at 8.

139. The removal of 250,000 acres from production translates to a loss of approximately 4,200 permanent agricultural worker positions. SLDMWA Ex. 155 at 19. Water shortages also cause jobs to be lost in agriculture-related businesses, such as packing sheds, processing plants, and other related services. *Id.* The projected agriculture-related wage loss for the San Joaquin Valley stands at \$1.6 billion. *Id.*

140. Dr. Michael, Defendant Intervenor's economist with expertise in regional and environmental economics, counters that "[a]lthough water impacts have affected parts of the west side, there is no evidence that reduced water deliveries have had a severe effect on farm or nonfarm employment in the Central Valley as a whole." D-I Exh. 1006 (Michael Decl.) 10. Instead, it is a combination of factors, including the three-year drought, the global economic recession, the foreclosure crisis, and the collapse of the real estate market and construction industry, not RPA Component 3, that are mainly driving crop and job losses, food bank needs, and credit problems in

the Central Valley. *Id.* at 6-10. Dr. Michael estimates that ESA-related pumping restrictions have resulted in the loss of less than 2,000 jobs. *See id.* at 4.

141. Unemployment has led to hunger on the west side of the San Joaquin Valley. SLDMWA Ex. 158 at 8. The Community Food Bank, serving Fresno, Madera and Kings Counties, estimates 435,000 people in its service area do not have a reliable source of food. SLDMWA Ex. 158 at 4. The Chief Executive Officer of the Community Food Bank, Dana Wilkie, believes that hunger in the communities served by the Food Bank in the western San Joaquin Valley will continue to increase in 2010 \*1056 because of ongoing water shortages. SLDMWA Ex. 158 at 5. Ms. Wilkie understands that at least 42,000 people served by the Food Bank in October 2009 were employed by farm-related businesses before losing their jobs. SLDMWA Ex. 158 at 8.

(5) *Groundwater Consumption and Overdraft.*

142. Reductions in the available water supply have caused water users to increase groundwater pumping in attempts to make up the difference between irrigation need and allocated water supplies. SLDMWA Ex. 155 at 4, 7; SLDMWA Ex. 157 at 10; 4/6/10 Tr. 216:6-7.

143. However, groundwater is not always available, and cannot be used in all areas or for all crops. SLDMWA Ex. 155 at 11. Increased groundwater pumping reduces the quality of water applied to the soil by increasing soil salinity. SLDMWA *Id.* at 15. Not all fields and crops can be irrigated with groundwater. *Id.* at 11, 15.

144. Increased reliance on and overuse of groundwater has caused groundwater overdraft, which occurs when pumping exceeds the safe yield of an aquifer. *Id.* at 12. Overdraft causes increased land subsidence and potential damage to CVP conveyance facilities, *id.* at 12-13, although it is not clear that any subsidence of Project facilities has occurred as a result of the implementation of the 2008 Smelt BiOp RPA Actions, as the only reported incident of subsidence at a SWP conveyance facility predates current implementation, 4/7/10 Tr. 16:1-13.

145. Increased groundwater pumping also increases demand for energy. SLDMWA Ex. 155 at 16.

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Due to the falling water table, wells require increased amounts of energy. *Id.* Westlands estimates that pumping of groundwater in 2009 required approximately 425,000,000 kWh. *Id.* Adverse environmental impacts are associated with such increased demand for and use of energy. *Id.*

146. Increased groundwater pumping has depleted groundwater reserves. Groundwater reserves that were at 2 million AF in the beginning of 2007 are now less than 900,000 AF. 4/6/10 Tr. 216:21-24. Within MWD's service area, storage levels are at 1.3 million AF, about half of normal storage levels. 4/6/10 Tr. 217:4-8.

(6) *Related, Recent Impacts on Naval Air Station Lemoore.*

147. Captain James Knapp testified as a fact witness on behalf of Naval Air Station Lemoore, which is located approximately 30 miles south of Fresno, eight miles west of the town of Lemoore, California. 4/7/10 Tr. 208:12-14. Its daytime population is approximately 14,000 people, including residents, who are sailors and dependent families. *Id.* at 208:15-21.

148. The air station's location was selected at a time when the Navy was transitioning from propeller-driven aircraft to jet aircraft, the latter being incompatible with urban environments such as the Naval Air Station Alameda in the San Francisco Bay Area. *Id.* at 211:17-212:21. The air station's 18,000 acres of agriculture-compatible land and neighboring land under permanent agricultural easements help to ensure there will be no urban build-out to interfere with the Navy's operations. *Id.* at 211:17-212:21, 213:2-19. From its location, the installation supports aircraft carrier activities along the Pacific Coast. *Id.*

149. Active agricultural operations on the air station's 18,000 acres and in the surrounding areas also serve "to control bird and animal strike hazards, grass fires, rodent activity, dust, and the release of [Coccidioidomycosis](#) (Valley Fever) spores carried by dust." SLDMWA Ex. 390 at p. 3. These risks are interrelated; for example, fallowed fields attract rodents and \*1057 predatory birds. 4/7/10 Tr. at 213:10-25. An increased bird presence increases the chances of bird strikes by naval aircraft. *Id.* at 214:1-6.

150. Ongoing agricultural activities are vitally

important to the Navy's ability to safely train and support flight operations at Naval Air Station Lemoore. 4/7/10 Tr. at 214:7-24; SLDMWA Ex. 390 at p. 2.

151. Lemoore Naval Air Station's principal source of municipal, industrial, and agricultural water is Westlands Water District. 4/7/10 Tr. 208:24-209:2.

152. The past water year began with a zero percent water allocation which increased to a ten percent allocation, resulting in 6,000 acres of fallow fields. SLDMWA Ex. 390 at p. 3. Pilots training at low altitude witnessed an increase in bird activity, with one aircraft suffering thousands of dollars in damage as a result of a bird strike. *Id.*

43. Captain Knapp testified that Naval Air Station Lemoore had requested and received emergency supplemental water allocations from Reclamation for these properties. *Id.* at 210, 217-18; SLDMWA Ex. 391.

44. This post-record evidence is received for the limited purpose of showing the action agency's ability to respond to conditions that pose imminent harm to the human environment.

(3) *Harm to Species.*

45. To the extent such information is in the record, the potential harms to the species of enjoining Component 2 (Action 3) are discussed above.

## VI. CONCLUSIONS OF LAW

### A. *Jurisdiction.*

1. Jurisdiction over claims brought under NEPA exists under [28 U.S.C. 1331](#) (Federal Question) and the Administrative Procedure Act ("APA"), [5 U.S.C. 702 et seq.](#) Jurisdiction over the ESA claims exists under the ESA citizen-suit provision, [16 U.S.C. 1540\(g\)\(1\)\(A\)](#). Personal jurisdiction over all the parties exists by virtue of their participation in the lawsuit as Plaintiffs, Defendants, and Interveners.

### B. *Likelihood of Success on the Merits: NEPA Claims.*

[\[1\]](#) 2. Plaintiffs have already succeeded on their NEPA claim. *See* Doc. 399.

3. NEPA insures that federal agencies "make in-

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formed decisions and ‘contemplate the environmental impacts of [their] actions.’ ” [Ocean Mammal Inst. v. Gates](#), 546 F.Supp.2d 960, 971 (D.Hi.2008) (quoting [Idaho Sporting Cong. v. Thomas](#), 137 F.3d 1146, 1149 (9th Cir.1998)).

4. “NEPA emphasizes the importance of coherent and comprehensive up-front environmental analysis to insure informed decision-making to the end that the agency will not act on incomplete information, only to regret its decision after it is too late to correct.” [Ctr. for Biological Diversity v. U.S. Forest Serv.](#), 349 F.3d 1157, 1166 (9th Cir.2003).

5. Federal Defendants' violations of NEPA prevented the required reasonable evaluation, analysis, “hard look at,” and disclosure of the harms of implementing the 2008 Smelt BiOp RPA Actions to human health and safety, the human environment, and other environments not inhabited by the delta smelt.

6. Harms that have been caused by RPA water supply reductions include but are not limited to: destruction of permanent crops; fallowed lands; increased groundwater consumption; land subsidence; reduction of air quality; destruction of family and entity farming businesses; and social disruption and dislocation, such as increased property crime and intra-family crimes of violence,\*1058 adverse effects on schools, and increased unemployment leading to hunger and homelessness.

7. Where a federal agency takes action in violation of NEPA, “that action will be set aside.” [High Sierra Hikers Ass'n v. Blackwell](#), 390 F.3d 630, 640 (9th Cir.2004).

8. However, a court may not issue an injunction under NEPA that would cause a violation of other statutory requirements, such as those found in section 7 of the ESA. See [United States v. Oakland Cannabis Buyers' Co-op.](#), 532 U.S. 483, 497, 121 S.Ct. 1711, 149 L.Ed.2d 722 (2001) (“A district court cannot, for example, override Congress' policy choice, articulated in a statute, as to what behavior should be prohibited.”). Nor should an injunction issue under NEPA when enjoining government action would result in more harm to the environment than denying injunctive relief. [Save Our Ecosystems v. Clark](#), 747 F.2d 1240, 1250 (9th Cir.1984); [Am. Motorcyclist Ass'n v. Watt](#), 714 F.2d 962, 966 (9th Cir.1983)

(holding public interest does not favor granting an injunction where “government action allegedly in violation of NEPA might actually jeopardize natural resources”); [Alpine Lakes Prot. Soc'y v. Schlaffer](#), 518 F.2d 1089, 1090 (9th Cir.1975) (denying injunctive relief in NEPA case where more harm could occur to forest from disease if injunction was granted).

### C. Likelihood of Success on the Merits: ESA Claims.

#### (1) Legal Standards.

9. The Administrative Procedure Act (“APA”) requires Plaintiffs to show that FWS's action was “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.” 5 U.S.C. 706(2)(A).

##### a. Record Review.

[2][3] 10. A court reviews a biological opinion “based upon the evidence contained in the administrative record.” [Arizona Cattle Growers' Ass'n v. FWS](#), 273 F.3d 1229, 1245 (9th Cir.2001). Judicial review under the APA must focus on the administrative record already in existence, not some new record made initially in a reviewing court. Parties may not use “post-decision information as a new rationalization either for sustaining or attacking the agency's decision.” [Ass'n of Pac. Fisheries v. EPA](#), 615 F.2d 794, 811-12 (9th Cir.1980).

[4] 11. Exceptions to administrative record review for technical information or expert explanation make such evidence admissible only for limited purposes, and those exceptions are narrowly construed and applied. [Lands Council v. Powell](#), 395 F.3d 1019, 1030 (9th Cir.2005).

12. Here, the Court has considered expert testimony only for explanation of technical terms and complex subject matter beyond the Court's knowledge; to understand the agency's explanations, or lack thereof, underlying the RPA; and to determine if any bad faith existed.

##### b. Deference to Agency Expertise.

[5][6] 13. The Court must defer to the agency on matters within the agency's expertise, unless the agency completely failed to address some factor, consideration of which was essential to making an

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informed decision. *Nat'l Wildlife Fed'n v. NMFS*, 422 F.3d 782, 798 (9th Cir.2005). The court “may not substitute its judgment for that of the agency concerning the wisdom or prudence of the agency's action.” *River Runners for Wilderness v. Martin*, 593 F.3d 1064, 1070 (9th Cir.2010).

In conducting an APA review, the court must determine whether the agency's decision is “founded on a rational connection between the facts found and the choices made ... and whether [the agency] has committed a clear error of judgment.” \*1059 *Ariz. Cattle Growers' Ass'n v. U.S. Fish & Wildlife*, 273 F.3d 1229, 1243 (9th Cir.2001). “The [agency's] action ... need be only a reasonable, not the best or most reasonable, decision.” *Nat'l Wildlife Fed. v. Burford*, 871 F.2d 849, 855 (9th Cir.1989).

*Id.*

14. Although deferential, judicial review under the APA “is designed to ensure that the agency considered all of the relevant factors and that its decision contained no clear error of judgment.” *Arizona v. Thomas*, 824 F.2d 745, 748 (9th Cir.1987) (internal citations omitted). “The deference accorded an agency's scientific or technical expertise is not unlimited.” *Brower v. Evans*, 257 F.3d 1058, 1067 (9th Cir.2001) (internal citations omitted). Deference is not owed when “the agency has completely failed to address some factor consideration of which was essential to making an informed decision.” *Id.* (internal citations and quotations omitted).

[An agency's decision is] arbitrary and capricious if it has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.

*Motor Vehicle Mfrs. Ass'n of U.S. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43, 103 S.Ct. 2856, 77 L.Ed.2d 443 (1983); see also *Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 416, 91 S.Ct. 814, 28 L.Ed.2d 136 (1971) (“A reviewing court may overturn an agency's action as arbitrary and capricious if the agency failed to consider rele-

vant factors, failed to base its decision on those factors, and/or made a clear error of judgment.”).

#### c. General Obligations Under the ESA.

15. ESA Section 7(a)(2) prohibits agency action that is “likely to jeopardize the continued existence” of any endangered or threatened species or “result in the destruction or adverse modification” of its critical habitat. 16 U.S.C. 1536(a)(2).

[7] 16. To “jeopardize the continued existence of” means “to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.” 50 C.F.R. 402.02; see also *Nat'l Wildlife Fed'n v. NMFS*, 524 F.3d 917 (9th Cir.2008) (“*NWF v. NMFS II*”) (rejecting agency interpretation of 50 C.F.R. 402.02 that in effect limited jeopardy analysis to survival and did not realistically evaluate recovery, thereby avoiding an interpretation that reads the provision “and recovery” entirely out of the text). An action is “jeopardizing” if it keeps recovery “far out of reach,” even if the species is able to cling to survival. *Id.* at 931.

[8][9] 17. “[A]n agency may not take action that will tip a species from a state of precarious survival into a state of likely extinction. Likewise, even where baseline conditions already jeopardize a species, an agency may not take action that deepens the jeopardy by causing additional harm.” *Id.* at 930.

18. To satisfy this obligation, the federal agency undertaking the action (the “action agency”) must prepare a “biological assessment” that evaluates the action's potential impacts on species and species' habitat. 16 U.S.C. 1536(c); 50 C.F.R. 402.12(a).

19. If the proposed action “is likely to adversely affect” a threatened or endangered species or adversely modify its designated\*1060 critical habitat, the action agency must engage in “formal consultation” with FWS to obtain its biological opinion as to the impacts of the proposed action on the listed species. 16 U.S.C. 1536(a)(2), (b)(3); see also 50 C.F.R. 402.14(a), (g). Once the consultation process has been completed, FWS must give the action agency a written biological opinion “setting forth [FWS's] opinion, and a summary of the information on which

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the opinion is based, detailing how the agency action affects the species or its critical habitat.” [16 U.S.C. 1536\(b\)\(3\)\(A\)](#); see also [50 C.F.R. 402.14\(h\)](#).

20. If FWS determines that jeopardy or destruction or adverse modification of critical habitat is likely, FWS “shall suggest those reasonable and prudent alternatives which [it] believes would not violate subsection (a)(2) of this section and can be taken by the Federal agency or applicant in implementing the agency action.” [16 U.S.C. 1536\(b\)\(3\)\(A\)](#). “Following the issuance of a ‘jeopardy’ opinion, the agency must either terminate the action, implement the proposed alternative, or seek an exemption from the Cabinet-level Endangered Species Committee pursuant to [16 U.S.C. 1536\(e\)](#).” *National Ass’n of Home Builders v. Defenders of Wildlife*, 551 U.S. 644, 652, 127 S.Ct. 2518, 168 L.Ed.2d 467 (2007).

d. *Best Available Science*.

[10] 21. Under the ESA, an agency’s actions must be based on “the best scientific and commercial data available.” [16 U.S.C. 1536\(a\)\(2\)](#); [50 C.F.R. 402.14\(g\)\(8\)](#) (“In formulating its Biological Opinion, any reasonable and prudent alternatives, and any reasonable and prudent measures, the Service will use the best scientific and commercial data available.”). “The obvious purpose of the [best available science requirement] is to ensure that the ESA not be implemented haphazardly, on the basis of speculation or surmise.” *Bennett v. Spear*, 520 U.S. 154, 176, 117 S.Ct. 1154, 137 L.Ed.2d 281 (1997). A failure by the agency to utilize the best available science is arbitrary and capricious. See *Pacific Coast Federation of Fishermen’s Associations v. Gutierrez, II*, 606 F.Supp.2d 1122, 1144 (E.D.Cal.2008).

22. A decision about jeopardy must be made based on the best science available at the time of the decision; the agency cannot wait for or promise future studies. See *Ctr. for Biological Diversity v. Rumsfeld*, 198 F.Supp.2d 1139, 1156 (D.Ariz.2002).

[11] 23. The “best available science” mandate of the ESA sets a basic standard that “prohibits the [agency] from disregarding available scientific evidence that is in some way better than the evidence [it] relies on.” *Am. Wildlands v. Kempthorne*, 530 F.3d 991, 998 (D.C.Cir.2008) (citation omitted).

24. What constitutes the “best” available science

implicates core agency judgment and expertise to which Congress requires the courts to defer; a court should be especially wary of overturning such a determination on review. *Baltimore Gas & Elec. Co. v. Natural Res. Defense Council*, 462 U.S. 87, 103, 103 S.Ct. 2246, 76 L.Ed.2d 437 (1983) (a court must be “at its most deferential” when an agency is “making predictions within its area of special expertise, at the frontiers of science”). As explained by the en banc panel of the Ninth Circuit in *Lands Council v. McNair*, 537 F.3d 981, 993 (9th Cir.2008), courts may not “impose on the agency their own notion of which procedures are best or most likely to further some vague, undefined public good.” *Id.* In particular, an agency’s “scientific methodology is owed substantial deference.” *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 378 F.3d 1059, 1066 (9th Cir.2004).

25. This deference extends to the use and interpretation of statistical methodologies.\*1061 As explained by the D.C. Circuit in *Appalachian Power Co. v. EPA*, 135 F.3d 791 (D.C.Cir.1998), in reviewing a challenge to a decision of the Environmental Protection Agency (“EPA”) under the “arbitrary and capricious” standard of review:

Statistical analysis is perhaps the prime example of those areas of technical wilderness into which judicial expeditions are best limited to ascertaining the lay of the land. Although computer models are “a useful and often essential tool for performing the Herculean labors Congress imposed on EPA in the Clean Air Act,” [citation] their scientific nature does not easily lend itself to judicial review. Our consideration of EPA’s use of a regression analysis in this case must therefore comport with the deference traditionally given to an agency when reviewing a scientific analysis within its area of expertise without abdicating our duty to ensure that the application of this model was not arbitrary.

*Id.* at 802.

[12] 26. More generally, “[w]hen specialists express conflicting views, an agency must have discretion to rely on the reasonable opinions of its own qualified experts even if, as an original matter, a court might find contrary views more persuasive.” *Lands Council*, 537 F.3d at 1000 (quoting *Marsh v.*

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[\*Oregon Natural Res. Council\*, 490 U.S. 360, 378, 109 S.Ct. 1851, 104 L.Ed.2d 377 \(1989\)\)](#).

[13] 27. Mere uncertainty, or the fact that evidence may be “weak,” is not fatal to an agency decision. [\*Greenpeace Action v. Franklin\*, 14 F.3d 1324, 1337 \(9th Cir.1992\)](#) (upholding biological opinion, despite uncertainty about the effectiveness of management measures, because decision was based on a reasonable evaluation of all available data); [\*Nat'l Wildlife Fed'n v. Babbitt\*, 128 F.Supp.2d 1274, 1300 \(E.D.Cal.2000\)](#) (holding that the “most reasonable” reading of the best scientific data available standard is that it “permits the [FWS] to take action based on imperfect data, so long as the data is the best available”).

28. The deference afforded under the best available science standard is not unlimited. For example, [\*Tucson Herpetological Society v. Salazar\*, 566 F.3d 870, 879 \(9th Cir.2009\)](#), held that an agency may not rely on “ambiguous studies as evidence” to support findings made under the ESA. Because the studies did not lead to the conclusion reached by FWS, the Ninth Circuit held that these studies provided inadequate support in the administrative record for the determination made by FWS. *Id.*; see also [\*Rock Creek Alliance v. U.S. Fish & Wildlife Service\*, 390 F.Supp.2d 993 \(D.Mont.2005\)](#) (rejecting FWS's reliance on a disputed scientific report, which explicitly stated its analysis was not applicable to the small populations addressed in the challenged opinion); [\*Greenpeace v. NMFS\*, 80 F.Supp.2d 1137, 1149-50 \(W.D.Wash.2000\)](#) (where agency totally failed to develop any projections regarding population viability, it could not use as an excuse the fact that relevant data had not been analyzed).

[14][15] 29. The presumption of agency expertise may be rebutted if the agency's decisions, although based on scientific expertise, are not reasoned. [\*Greenpeace\*, 80 F.Supp.2d at 1147](#). Agencies cannot disregard available scientific evidence better than the evidence on which it relies. [\*Kern County Farm Bureau v. Allen\*, 450 F.3d 1072, 1080 \(9th Cir.2006\)](#); [\*S.W. Ctr. for Biological Diversity v. Babbitt\*, 215 F.3d 58, 60 \(D.C.Cir.2000\)](#).

30. Courts routinely perform substantive reviews of record evidence to evaluate the agency's treatment of best available science. The judicial review process

is not one of blind acceptance. See, e.g., [\*\\*1062Kern County\*, 450 F.3d 1072](#) (thoroughly reviewing three post-comment studies and FWS's treatment of those studies to determine whether they “provide[d] the sole, essential support for” or “merely supplemented” the data used to support a listing decision); [\*Home Builders Ass'n of N. Cal. v. U.S. Fish and Wildlife Serv.\*, 529 F.Supp.2d 1110, 1120 \(N.D.Cal.2007\)](#) (examining substance of challenge to FWS's determination that certain data should be disregarded); [\*Trout Unlimited v. Lohn\*, 645 F.Supp.2d 929 \(D.Or.2007\)](#) (finding best available science standard had been violated after thorough examination of rationale for NMFS's decision to withdraw its proposal to list Oregon Coast Coho salmon); [\*Oceana, Inc. v. Evans\*, 384 F.Supp.2d 203, 217-18 \(D.D.C.2005\)](#) (carefully considering scientific underpinnings of challenge to Service's use of a particular model, including post decision evidence presented by an expert, to help the court understand a complex model, applying one of several record review exceptions articulated in [\*Esch v. Yeutter\*, 876 F.2d 976, 991 \(D.C.Cir.1989\)](#), which are similar to those articulated by the Ninth Circuit).

[16] 31. Courts are not required to defer to an agency conclusion that runs counter to that of other agencies or individuals with specialized expertise in a particular technical area. See, e.g., [\*Am. Tunaboat Ass'n v. Baldrige\*, 738 F.2d 1013, 1016-17 \(9th Cir.1984\)](#) (NMFS's decision under the Marine Mammal Protection Act was not supported by substantial evidence because agency ignored data that was product of “many years' effort by trained research personnel”); [\*Sierra Club v. U.S. Army Corps of Eng'rs\*, 701 F.2d 1011, 1030 \(2d Cir.1983\)](#) (“court may properly be skeptical as to whether an EIS's conclusions have a substantial basis in fact if the responsible agency has apparently ignored the conflicting views of other agencies having pertinent experience [ ]”) (internal citations omitted). A court should “reject conclusory assertions of agency ‘expertise’ where the agency spurns un rebutted expert opinions without itself offering a credible alternative explanation.” [\*N. Spotted Owl v. Hodel\*, 716 F.Supp. 479, 483 \(W.D.Wash.1988\)](#) (citing [\*Am. Tunaboat Ass'n\*, 738 F.2d at 1016](#)).

32. In [\*Conner v. Burford\*, 848 F.2d 1441, 1453-54 \(9th Cir.1988\)](#), the agency attempted to defend its biological opinions by arguing that there was a lack of sufficient information. In rejecting this defense,

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the court held that “incomplete information ... does not excuse the failure to comply with the statutory requirement of a comprehensive biological opinion using the best information available,” and it noted that FWS could have completed more analysis with the information that was available. *Id.* at 1454 (emphasis added). The Ninth Circuit stated:

In light of the ESA requirement that the agencies use the best scientific and commercial data available ... the FWS cannot ignore available biological info or fail to develop projections of ... activities which may indicate potential conflicts between development and the preservation of protected species. We hold that the FWS violated the ESA by failing to use the best information available to prepare comprehensive biological opinions.

[848 F.2d at 1454](#) (emphasis added).

(2) *Environmental Baseline Challenges.*

33. The relevant regulatory definition of the “environmental baseline” is provided within the definition of the “effects of the action”:

the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. The environmental baseline \*1063 includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process.

[50 C.F.R. 402.02.](#)

34. When determining the “effects of the action,” the agency first must evaluate the status of the species or critical habitat, which will involve “consideration of the present environment” in which the species or habitat exists as well as “the environment that will exist when the action is completed, in terms of the totality of factors affecting the species or critical habitat.” [51 Fed.Reg. 19,926, 19,932 \(June 3, 1986\).](#)

This evaluation is to serve as the “baseline” for determining the effects of the action on the species or critical habitat. *Id.* However, all of these elements are to be evaluated together as the “effects of the action.”

35. If additional data would provide a better information base from which to formulate a biological opinion, the consulting agency (FWS or NMFS) may request an extension of formal consultation and that the action agency obtain additional data to determine how or to what extent the action may affect listed species or critical habitat. [50 C.F.R. 402.14\(f\)](#); FWS and NMFS, *Endangered Species Consultation Handbook* (March 1998) at 4-6.<sup>FN8</sup>

<sup>FN8</sup>. Judicial notice may be taken of this Handbook, which is available at: <http://www.fws.gov/endangered/consultations/s7hndbk/s7hndbk.htm>.

36. The Ninth Circuit directs the consulting agency to consider the effects of its actions “within the context of other existing human activities that impact the listed species.” [NWF v. NMFS II, 524 F.3d at 930](#). “[T]he proper baseline analysis is not the proportional share of responsibility the federal agency bears for the decline in the species, but what jeopardy might result from the agency’s proposed actions in the present and future human and natural contexts.” *Id.* The relevant jeopardy analysis is whether this Project will tip a species into a state of “likely extinction.” [524 F.3d at 930](#).

Even under the so-called aggregation approach NMFS challenges, then, an agency only “jeopardize[s]” a species if it causes some new jeopardy. An agency may still take action that removes a species from jeopardy entirely, or that lessens the degree of jeopardy. However, an agency may not take action that will tip a species from a state of precarious survival into a state of likely extinction. Likewise, even where baseline conditions already jeopardize a species, an agency may not take action that deepens the jeopardy by causing additional harm.

Our approach does not require NMFS to include the entire environmental baseline in the “agency action” subject to review. It simply requires that NMFS appropriately consider the effects of its actions “within the context of other existing human

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activities that impact the listed species.” [citation]. This approach is consistent with our instruction (which NMFS does not challenge) that “[t]he proper baseline analysis is not the proportional share of responsibility the federal agency bears for the decline in the species, but what jeopardy might result from the agency’s proposed actions in the present and future human and natural contexts.” [citation].

*Id.* (footnote omitted).

37. Plaintiffs’ essential critique of the BiOp’s baseline analysis is that the BiOp \*1064 improperly concluded that “CVP and SWP operations exacerbate the effects of other factors, such as food or predation on the delta smelt.” *See* Doc. 667, Plt’s Proposed Conclusions of Law 316-18.<sup>FN9</sup> Plaintiffs argue “FWS simply determined that these factors are attributable to CVP and SWP operations” and therefore “based the effects analysis of the 2008 BiOp upon an unreasoned premise.” *Id.* at Proposed Conclusion of Law # 343.

<sup>FN9</sup>. Plaintiffs’ motion for preliminary injunction specifically addresses the treatment of hatcheries and gravel loss below Whiskeytown Dam. Doc. 164 at 11-12. However, this issue was not presented or discussed at the evidentiary hearing or in Plaintiffs’ proposed findings. These specific arguments appear to have been abandoned.

Plaintiffs also advance an elaborate argument based on the contention that FWS misapplied the “reasonably certain to occur” standard applicable to “indirect effects” analyses. Because Component 2 is not explicitly justified by any indirect effects analysis, this argument is not directly relevant to the resolution of the pending motion for preliminary injunction.

38. Plaintiffs are correct that the general assertion that Project operations exacerbate the effects of these other stressors is unsupported by the record. However, the inclusion of this unsupported assertion does not invalidate the BiOp’s baseline analysis. BiOp at 140-189. FWS does discuss “other stressors” at length in the BiOp. *See, e.g., id.* at 182-88, 198, 201-2. Specifically, FWS considered the effects of

“predation, contaminants, introduced species ..., habitat suitability, food supply, aquatic macrophytes, and microcystis.” *Id.* at 202, 277. The CVP and SWP are not identified as the sole source of the delta smelt’s problems. Rather, FWS expressly recognizes that the long-term decline of the species “was very strongly affected by ecosystem changes caused by non-indigenous species invasions and other factors....” *Id.* at 189. The BiOp repeatedly acknowledges that there is “no single primary driver of delta smelt population dynamics,” *id.* at 202, but rather that there are “multiple factors” and that “not all are directly influenced by operations of the CVP/SWP.” *Id.* at 328.

39. It is undisputed that uncertainty surrounding the measurement of the other stressors makes it difficult (if not impossible) to separate those effects from the effects of joint Project operations. Even if it were possible to separate the quantitative effect of the other stressors, which are part of the environmental baseline, the ESA does not require that FWS quantify and/or parcel out the “proportional share” of harms among the baseline and the proposed action. *See Pacific Coast Fed’n of Fishermen’s Ass’ns v. U.S. Bureau of Reclamation*, 426 F.3d 1082, 1093 (9th Cir.2005); *see also Pacific Coast Fed’n of Fishermen’s Ass’ns v. U.S. Bureau of Reclamation*, 226 Fed.Appx. 715, 718 (9th Cir.2007) (rejecting water users’ argument that agency action must be the “historical cause” of the jeopardy to salmon).

40. FWS’s treatment of the “other stressors” in the BiOp did not violate the ESA’s baseline analysis requirements because the ESA does not demand a quantitative separation of project stressors from non-project stressors. *See NWF v. NMFS II*, 524 F.3d at 930. (“[T]he proper baseline analysis is not the proportional share of responsibility the federal agency bears for the decline in the species, but what jeopardy might result from the agency’s proposed actions in the present and future human and natural contexts.”). FWS was required to and did describe the present and future federal, state, and private actions in the action area, which include the “other stressors”. Whether it sufficiently justified whether jeopardy might result \*1065 from the agency’s proposed actions viewed in this context is a separate question.

41. It is inequitable to put the entire burden of the stressors on the water supply. However, this decision goes beyond science to implicate the Executive’s

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(Department of Interior) allocation of resources. A court lacks authority to interfere with such a policy choice by a coordinate branch of government.

a. *Discretionary v. Non-Discretionary.*

42. Plaintiffs complain that the BiOp does not distinguish between discretionary and non-discretionary actions. [\*Home Builders\*, 551 U.S. 644, 127 S.Ct. 2518](#), held that ESA 7's consultation requirements do not apply to non-discretionary actions. Where an agency is *required* by law to perform an action, it lacks the power to insure that the action will not jeopardize the species. *Id.* at 667, 127 S.Ct. 2518.

43. However, *Home Builders* says nothing about whether, once section 7 consultation is triggered, the jeopardy analysis should segregate discretionary and non-discretionary actions, relegating the non-discretionary actions to the environmental baseline. *Home Builders* fundamentally concerns whether the section 7 consultation obligation attaches to a particular agency action at all. See [\*Home Builders\*, 551 U.S. at 679-80, 127 S.Ct. 2518](#) (“duty does not *attach* to actions ... that an agency is required by statute to undertake....”) (emphasis added).

b. *Reclamation's Treatment of the Coordinated Operations Agreement.*

The same reasoning applies to Plaintiffs' related argument that Federal Defendants acted unlawfully by attributing to the project the effects of “mandatory” compliance with the Coordinated Operations Agreement (“COA”). Even assuming, *arguendo*, that any mandatory obligation exists under the COA, a proposition that is questionable given the open-ended wording of the COA and language in the CVPIA subjecting project operations to the ESA, [\*Home Builders\*](#) does not require the agency to segregate discretionary from non-discretionary activities during an ESA 7 consultation.<sup>FN10</sup> Moreover, this argument was not presented in Plaintiffs' opening brief. See [\*Alaska Ctr. for Env't. v. U.S. Forest Serv.\*, 189 F.3d 851, 858 n. 4 \(9th Cir.1999\)](#) (arguments not raised in opening brief are waived).

<sup>FN10</sup>. To the extent that Plaintiffs suggest that section 7 does not apply to the projects at all under [\*Home Builders\*](#), this paradigm-shifting argument has not properly been raised or briefed.

c. *Comparison of CalSim Data against Dayflow Data.*

44. Plaintiffs also argue that FWS's analysis is flawed because FWS compared CalSim data to Dayflow Data. As discussed in the Findings of Fact, although Mr. Miller presents some substantive criticisms of the way the BiOp utilized CalSim runs and compared those runs to other types of data, these specific concerns were not raised before the agency prior to the issuance of the BiOp. FWS had legitimate concerns, shared by other scientists, with the exclusive reliance on CalSim data. Finally, Mr. Miller concedes that even if the approach he recommends had been taken, the same fundamental result would have obtained: project operations shift the position of X2 upstream. The magnitude of this shift is relevant to the justification for and design of Component 3, which takes effect in September, but that need not be resolved at this time.

(3) *Effects Analysis Challenges (Food Web).*

45. Plaintiffs' original motion attacked the BiOp's analysis regarding *P. forbesi*, a \*1066 food item for delta smelt during the summer and fall seasons. Doc. 447 at 21-26. Plaintiffs appear to have abandoned this argument, as it was not discussed during the evidentiary hearing or in their proposed Findings of Fact or Conclusions of Law.

(4) *Challenges to Component 2.*

a. *Use of Raw Salvage Numbers.*

<sup>[17]</sup> 46. The evidence described in the Findings of Fact establishes that FWS's use of gross salvage numbers to justify the quantitative pumping restrictions in RPA Component 2 did not utilize the best available science.

47. There was agreement among all the experts that the best available, scientifically accepted methodology is to use normalized salvage data to analyze the effect of OMR flows on the delta smelt population. Normalized 110 salvage data was available to FWS, but FWS failed to incorporate any analysis of normalized salvage data into its quantitative justification for the specific flow prescriptions imposed by RPA Component 2. To exacerbate this failure, FWS did not explain why it did not.

48. FWS's disregard for an available scientific methodology that was “in some way better than the evidence [the agency] relied on” was a violation of

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the “best available science” standard of the ESA. [Kern County](#), 450 F.3d at 1080.

49. Additionally, by entirely failing to explain its use of gross salvage numbers despite internal discussions indicating an awareness of the problem and criticism from the Independent Peer Review, FWS “has entirely failed to articulate a satisfactory explanation for its conclusions.” [Gutierrez II](#), 606 F.Supp.2d at 1183.

50. Plaintiffs have shown a likelihood of success on the merits of their claim that the use of gross salvage numbers in Figures B-13 and B-14 of the BiOp was a violation of the ESA, and was arbitrary, capricious, and an abuse of discretion.

51. However, Plaintiffs have not demonstrated that Dr. Deriso's alternative -5,600 cfs flow limit is any more valid than the -5,000 cfs limit imposed by RPA Component 2. The condition of the delta smelt continues to be non-viable and precarious, with a likely risk of extinction if protections are not afforded. Plaintiffs must produce evidence that shows otherwise to justify a flow restriction that permits negative OMR flows to exceed -5,000 cfs.

*b. Failure to Use a Quantitative Life Cycle Model.*

52. The agency is not required to generate new studies. For example, in [Southwest Center for Biological Diversity v. Babbitt](#), 215 F.3d 58, 60-61 (D.C.Cir.2000), the district court found the available evidence regarding FWS's decision not to list the Queen Charlotte goshawk “inconclusive” and held that the agency was obligated to find better data on the species' abundance. The D.C. Circuit reversed, emphasizing that, although “the district court's view has a superficial appeal ... this superficial appeal cannot circumvent the statute's clear wording: The secretary must make his decision as to whether to list a species as threatened or endangered ‘solely on the basis of the best scientific and commercial data available to him....’ 16 U.S.C. 1533(b)(1)(A).” *Id.* at 61.

53. The use of a quantitative life cycle model is the preferred scientific methodology. FWS made a conscious choice not to use expertise available within the agency to develop one, nor did it explain why it did not. However, a completed life-cycle model was not available for FWS's use prior to the issuance of the BiOp, and the Court does not have the authority

to require the agency to create one.

**\*1067 (5) Critical Habitat.**

[\[18\]](#) 54. As required by the ESA, if FWS finds that the proposed agency action will result in “jeopardy or adverse modification [of critical habitat] ... the Secretary shall suggest those reasonable and prudent alternatives which [it] believes would not violate [Section 7(a)(2) ] and can be taken by the Federal agency or applicant in implementing the agency action.” 16 U.S.C. 1536(b)(3)(A). Avoiding adverse modification of critical habitat is an independent statutory basis for the promulgation of an RPA.

55. The BiOp sets forth extensive findings regarding the adverse effects of export pumping on the critical habitat of the delta smelt. *See* BiOp at 190-202, 239-78. For instance, the BiOp found that the export pumps “alter the hydrologic conditions within spawning habitat throughout the spawning period for delta smelt by impacting various abiotic factors including the distributions of turbidity, food, and contaminants,” and further adversely modify spawning habitat by “contribut[ing] to upstream movement of the LSZ [low salinity zone],” which in turn “reduc[es] the amount and quality of spawning habitat available to delta smelt.” *Id.* at 239-40.

56. In light of such findings, the BiOp concluded that the operations of the CVP and SWP “are likely to adversely modify delta smelt critical habitat” because “[t]he past and present operations of the CVP/SWP have degraded [delta smelt] habitat elements (particularly PCEs 2-4 [“primary constituent elements” water, water flow, and salinity] ) to the extent that their co-occurrence at the appropriate places and times is insufficient to support successful delta smelt recruitment at levels that will provide for the species' conservation.” *Id.* at 278.

57. Plaintiffs have not challenged the BiOp's findings on adverse modification of critical habitat in this motion. Plaintiffs' experts Dr. Deriso and Dr. Hilborn stated that their criticisms of the BiOp's OMR flow restrictions did not apply to critical habitat. 4/5/10 Tr. 226; 4/6/10 Tr. 93. Rather, Plaintiffs argue that the only stated rationale for the specific flow prescriptions imposed by Component 2 is to avoid jeopardy, and that Component 2 does not itself indicate that it is necessary to prevent adverse modification. *See* Pls.' Reply (Doc. 491) at 1 n. 1.

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58. Federal Defendants respond that “[t]his argument elevates form over substance and needlessly compartmentalizes portions of the BiOp that are designed to work together as part of the same document.” Doc. 666, Proposed Conclusion of Law # 187.

59. As a general matter, Federal Defendants are correct that the BiOp’s critical habitat modification finding operates as an independent justification for imposing flow restrictions on the projects. However, the BiOp justifies the *specific* flow prescriptions imposed by Component 2 with a quantitative analysis that says nothing whatsoever about critical habitat. Rather, an improper analysis of raw salvage data is utilized to generate a series of “break points,” including a -5,000 cfs ceiling on negative OMR flows. There is no analysis of critical habitat that independently justifies this specific flow prescription, as opposed to the ceiling of -5,600 proposed by Plaintiffs, or any other level.

(6) *Reclamation’s ESA Responsibility.*

60. The ESA regulations require the action agency to “determine whether and in what manner to proceed with the action in light of its section 7 obligations and the Service’s biological opinion.” [50 C.F.R. 402.15\(a\)](#). Prior to accepting and implementing the 2008 Smelt BiOp RPA, Reclamation had an independent obligation under ESA section 7(a)(2) to ensure that it \*1068 “use[d] the best scientific and commercial data available.”

[\[19\]\[20\]](#) 61. Reclamation, as the federal action agency, “may not rely solely on a FWS biological opinion to establish conclusively its compliance with its substantive obligations under section 7(a) (2).” [Pyramid Lake Paiute Tribe of Indians v. U.S. Dept. of the Navy](#), 898 F.2d 1410, 1415 (9th Cir.1990). “[T]he action agency must not blindly adopt the conclusions of the consultant agency.” [City of Tacoma v. Fed. Energy Regulatory Comm’n](#), 460 F.3d 53, 76 (D.C.Cir.2006).

62. Reclamation did not ensure that the RPA utilized the best available science. Rather, it uncritically accepted the RPA and did not independently identify and analyze alternative RPA Actions that minimized jeopardy to humans and the human environment while protecting threatened species.

D. *Balancing of the Harms.*

(1) *Balancing of the Harms in ESA Cases.*

63. The Supreme Court held in [TVA v. Hill](#), 437 U.S. 153, 194, 98 S.Ct. 2279, 57 L.Ed.2d 117 (1978), that Congress struck the balance in favor of affording endangered species the highest of priorities. In adopting the ESA, Congress intended to “halt and reverse the trend toward species’ extinction, *whatever the cost*.” [Id.](#) at 184, 98 S.Ct. 2279 (emphasis added). [TVA v. Hill](#) continues to be viable. See [Home Builders](#), 551 U.S. at 669-71, 127 S.Ct. 2518; see also [Oakland Cannabis Buyers’ Co-op.](#), 532 U.S. at 496-97, 121 S.Ct. 1711; [Amoco Prod. Co. v. Village of Gambell](#), 480 U.S. 531, 543 n. 9, 107 S.Ct. 1396, 94 L.Ed.2d 542 (1987).

64. Winter does not modify or discuss the [TVA v. Hill](#) standard.<sup>[FN11](#)</sup> Although Winter altered the Ninth Circuit’s general preliminary injunctive relief standard by making that standard *more rigorous*, Winter did not address, nor change, the approach to the balancing of *economic* hardships where endangered species and their critical habitat are jeopardized. See [Biodiversity Legal Found. v. Badgley](#), 309 F.3d 1166, 1169 (9th Cir.2002) (Congress removed the courts’ traditional equitable discretion to balance parties’ competing interests in ESA injunction proceedings); [Nat’l Wildlife Fed’n v. Burlington N. R.R., Inc.](#), 23 F.3d 1508, 1510-11 (9th Cir.1994) (same).

<sup>[FN11](#)</sup>. Although [Winter](#) involved ESA-listed species, the [Winter](#) decision did not address any ESA claims.

65. Prior decisions involving the coordinated projects’ operations found that [TVA v. Hill](#) and related Ninth Circuit authorities foreclose the district court’s traditional discretion to balance economic equities under the ESA. There is no such bar in NEPA injunction proceedings.

66. Plaintiffs have advanced a human welfare exception and contend that unlike any of the prior cases, this case juxtaposes species’ survival against human welfare, requiring a balancing of the BiOp’s threats of harm to humans, health, safety, and protection of affected communities. No case, including [TVA](#)

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*v. Hill*, which concerned the competing economic interest in the operation of a hydro-electric project and prohibited federal courts from balancing the loss of funds spent on that project against the loss of an endangered species, expressly addresses whether the ESA precludes balancing of harms to humans and the human environment under the circumstances presented here.

67. This case involves both harm to threatened species and to humans and \*1069 their environment. Congress has not nor does *TVA v. Hill* elevate species protection over the health and safety of humans.

(2) *Balancing the Harms under NEPA.*

[21] 68. Although it is undisputed that all harms may be considered in evaluating a claim for injunctive relief under NEPA, an injunction should not issue if enjoining such government action would result in more harm to the environment than denying injunctive relief. *Save Our Ecosystems*, 747 F.2d at 1250.

E. *The Public Interest.*

69. In adopting the ESA, Congress explicitly found that all threatened and endangered species “are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people.” 16 U.S.C. 1531(a)(3). The ESA advances a Congressional policy to “halt and reverse the trend toward species extinction, whatever the cost.” *TVA v. Hill*, 437 U.S. at 184, 98 S.Ct. 2279.

70. The public policy underlying NEPA favors protecting the balance between humans and the environment. See 42 U.S.C. 4321 (declaring a national policy to “encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; [and] to enrich the understanding of the ecological systems and natural resources important to the Nation....”).

71. If both these objectives can be realized by astute management, it is the government's obligation to do so.

[22] 72. It is in the public interest that relief be granted to Plaintiffs, who represent a substantial population of water users in California, to enhance

the water supply to reduce the adverse harms of destruction of permanent crops; fallowed lands; increased groundwater consumption; reducing groundwater supplies; land subsidence; reduction of air quality; destruction of family and entity farming businesses; and social disruption and dislocation, such as increased property crimes and intra-family crimes of violence, adverse effects on schools, and increased unemployment leading to hunger and homelessness. This must be done without jeopardizing the species and their critical habitat.

## VII. CONCLUSION

1. Plaintiffs have succeeded on the merits of their NEPA claim.

a. NEPA requires that the responsible agency take a hard look at the environmental consequences of its actions, *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 [109 S.Ct. 1835, 104 L.Ed.2d 351] (1989), obligating federal agencies to prepare an environmental impact statement (“EIS”) for all “major federal actions significantly affecting the quality of the human environment.” 42 U.S.C. 4332(2)(C).

b. Federal Defendants are required to evaluate the impact of the coordinated operations of the CVP and SWP, which constitutes major federal action. The evidence overwhelmingly establishes significant detrimental effects visited on the quality of the human environment by implementation of the BiOp's RPA Actions, which impose substantial restrictions on the water supply to California to protect the delta smelt.

c. Where required, an EIS discloses environmental effects of a proposed action and considers alternative courses of action. *Id.* Here, Federal Defendants completely abdicated their responsibility to consider alternative remedies in formulating RPA Actions that would not only protect the species, but would also \*1070 minimize the adverse impact on humans and the human environment.

d. In considering RPA alternatives, the record shows the burden of other causes is allocated to the water supply, without the required analysis whether alternatives, less harmful to humans and the human environment, exist. Although this allocation of resources ultimately is the prerogative of the agency,

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NEPA nevertheless requires a hard look.

2. Plaintiffs have also shown a likelihood of success on the merits of their ESA claim. Although the premise underlying Component 2—that the species may be jeopardized by increased negative flows occasioned by export pumping—has record support, FWS has failed to adequately justify by generally recognized scientific principles the precise flow prescriptions imposed by Component 2. The exact restrictions imposed, which are inflicting material harm to humans and the human environment, are not supported by the record, making it impossible to determine whether RPA Component 2 overly protective. Judicial deference is not owed to arbitrary, capricious, and scientifically unreasonable agency action.

3. It is highly significant that the co-operator of the Projects, DWR, with access to scientific competence in the fields of fish biology and ecology, and project operations, does not oppose the motion for a preliminary injunction.

4. Under the balance of hardships analysis, Defendants' contention that the ESA, under [TVA v. Hill](#), precludes equitable weighing of Plaintiffs' interests is not supported by that case, as evidence of harm to the human environment in the form of social dislocation, unemployment, and other threats to human welfare were not present in [Hill](#). They are in this case.

5. Defendants argue that jeopardy to the species cannot be avoided without continuing substantial reduction of pumping, with resultant reduction of water supply to Plaintiffs, representing over 20,000,000 persons, affected communities, and the agricultural industry in Northern, Central, and Southern California.

6. Congress created public expectations in the Amended Reclamation Act by instructing Reclamation to contract for water service to hundreds of public-entity water service providers that supply water to millions of people and thousands of acres of productive agricultural land. The agencies have not fully discharged their responsibility to effectively allocate Project water resources. Federal Defendants have acted arbitrarily and capriciously in formulating Component 2 of the RPA, which lacks factual and scientific justification, while effectively ignoring the irreparable harm that pumping restrictions have in-

flicted and will inflict on humans and the human environment.

7. The species and its critical habitats are entitled to protection under the ESA. The species has been and will be protected. That is the law. Nonetheless, FWS and Reclamation, as the consulting and action agencies, must take the hard look under NEPA at the severe consequences visited upon Plaintiffs, the water supply of California, the agricultural industry, and the residents and communities impacted by the water supply limitations imposed by the Component 2. Federal Defendants have failed to comprehensively and competently evaluate whether RPA alternatives can be prescribed that will be mutually protective of all the statutory purposes of the Projects.

8. This is a case of first impression. The stakes are high, the harms to the affected human communities great, and the injuries unacceptable if they can be mitigated. FWS and Reclamation have not complied with NEPA. This prevented \*1071 in-depth analysis of the potential RPA Actions through a properly focused study to identify and select alternative remedial measures that minimize jeopardy to affected humans and their communities, as well as protecting the threatened species. No party has suggested that humans and their environment are less deserving of protection than the species. Until Defendant Agencies have complied with the law, some injunctive relief pending NEPA compliance may be appropriate, so long as it will not further jeopardize the species or their habitat.

9. Injunctive relief also may be warranted under the ESA, because, although the general premises underlying Component 2 find some support in the record, the precise flow prescriptions imposed on coordinated project operations are not supported by the best available science and are not explained as the law requires.

10. Injunctive relief cannot be imposed without current evidence of the status of the species to assure that altered operations will not deepen jeopardy to the affected species or otherwise violate other laws. The evidence has not sufficiently focused on remedies to provide a confidence level that Plaintiffs' proposed remedy of a flat -5,600 cfs ceiling on negative OMR flows will not jeopardize the continued existence of the species and/or adversely modify its critical habi-

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tat.

11. Legal and equitable grounds for injunctive relief have otherwise been established by a preponderance of the evidence.

12. RPA component 2 suffers from a lack of population scaling in violation of the requirement FWS use the best available science. There is no reliable life cycle model, which best available science calls for, even if the Court cannot require the agency to develop one. Continuing evidence of the extreme risk to the continued existence of the Delta smelt population has been presented by Defendants. Absent a showing by Plaintiffs that Delta smelt are not within imminent risk of entrainment by Project pumping facilities and/or not within hydraulic influence of the pumps in the danger area of the Central and South Delta, the -5,000 cfs flow restriction cannot be enjoined.

13. A telephonic conference to discuss whether Plaintiffs have evidence that imminence of harm to Delta smelt does not exist to justify injunction of pumping restrictions shall be held May 28, 2010 in Courtroom 3 at 10:00 a.m.

SO ORDERED.

E.D.Cal.,2010.  
Consolidated Delta Smelt Cases  
717 F.Supp.2d 1021

END OF DOCUMENT

## **APPENDIX DOC. 8**



**DELTA SMELT CONSOLIDATED CASES; SAN LUIS & DELTA-MENDOTA WATER AUTHORITY, et al. v. SALAZAR, et al. (1:09-cv-00407 OWW DLB); STATE WATER CONTRACTORS v. SALAZAR, et al. (1:09-CV-00480- OWW-GSA); COALITION FOR A SUSTAINABLE DELTA, et al. v. UNITED STATES FISH AND WILDLIFE SERVICE, et al. (1:09-cv-00422-OWW-GSA); METROPOLITAN WATER DISTRICT v. UNITED STATES FISH AND WILDLIFE SERVICE, et al. (1:09-cv-00631- OWW-DLB); STEWART & JASPER ORCHARDS et al. v. UNITED STATES FISH AND WILDLIFE SERVICE (1:09-cv- 00892-OWW-DLB); FAMILY FARM ALLIANCE v. SALAZAR, et al. (1:09-CV-01201- OWW-DLB)**

**1:09-cv-00407 OWW DLB,1:09-CV-00480-OWW-GSA,1:09-CV-00422-OWW-GSA,1:09-CV-00631-OWW-DLB,1:09-CV-00892-OWW-DLB PARTIALLY CONSOLIDATED WITH:1:09-CV-01201-OWW-DLB**

**UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF CALIFORNIA**

*760 F. Supp. 2d 855; 2010 U.S. Dist. LEXIS 132819; 41 ELR 20053*

**December 14, 2010, Decided**

**December 14, 2010, Filed**

**SUBSEQUENT HISTORY:** Summary judgment granted, in part, summary judgment denied, in part by, Remanded by *Delta Smelt Cases v. Salazar, 2010 U.S. Dist. LEXIS 135805 (E.D. Cal., Dec. 23, 2010)*

**PRIOR HISTORY:** *Consol. Delta Smelt Cases, 717 F. Supp. 2d 1021, 2010 U.S. Dist. LEXIS 62006 (E.D. Cal., 2010)*

**JUDGES:** Oliver W. Wanger, United States District Judge.

**OPINION BY:** Oliver W. Wanger

**OPINION**

[\*860] MEMORANDUM DECISION RE CROSS

MOTIONS FOR SUMMARY JUDGMENT (DOCS. 548, 549, 550, 658, & 661) [\*861]

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## [\*863] I. [\*\*10] INTRODUCTION

These consolidated cases arise out of the continuing war over protection of the delta smelt (*Hypomesus transpacificus*), an ESA-threatened species, and associated impacts to the water supply for more than half of the State of California. Plaintiffs, San Luis & Delta Mendota Water Authority ("SLDMWD") and Westlands Water District, Metropolitan Water District of Southern California, State Water Contractors ("SWC"), Coalition for a Sustainable Delta and Kern County Water Agency, Stewart & Jasper Orchards, Arroyo Farms, LLC, and King Pistacho Grove, and Family Farm Alliance, move for summary judgment on their numerous remaining claims against the United States Fish and Wildlife Service's ("FWS") December 15, 2008 Biological Opinion addressing the impacts of the coordinated operations of the federal Central Valley Project ("CVP") and State Water Project ("SWP") on the threatened delta smelt (*Hypomesus transpacificus*). Doc. 550. Plaintiff-in-Intervention, the California Department of Water Resources ("DWR") filed a separate motion for summary judgment on narrower grounds. Docs. 548 & 549. Federal Defendants, the United States Department of the Interior, FWS, and the United States [\*\*11] Bureau of Reclamation ("Reclamation"), and Defendant Intervenor, Natural Resources Defense Council and The Bay Institute, oppose and cross move for summary judgment

on all remaining claims. Docs. 658 & 661. Plaintiffs and DWR replied. Docs. 697 & 695. The motion came on for hearing on July 8 & 9, 2010. After oral argument, the parties submitted supplemental briefing on a limited set of issues. Docs. 746-49.

## II. PROCEDURAL HISTORY

FWS's 2005 biological opinion ("2005 Smelt BiOp") found that the proposed coordinated operations of the SWP and CVP will have no adverse effect on the continued existence and recovery of the Delta Smelt and its critical habitat. The 2005 BiOp was remanded to FWS as arbitrary and capricious. Order, *NRDC v. Kempthorne*, 506 F. Supp. 2d 322 (E.D. Cal. 2007), Doc. 323. Following an extensive evidentiary hearing, the Court issued an interim remedial order and Findings of Fact and Conclusions of Law ("Findings"), which covered, among other things, the effects on delta smelt of negative flows in Old and Middle Rivers ("OMR"), two distributary channels of the San Joaquin River. See Interim Remedial Order Following Summary Judgment and Evidentiary Hearing ("Int. Rem. [\*\*12] Order"), *NRDC v. Kempthorne*, Doc. 560 (Dec. 14, 2007); Findings re: Delta Smelt ESA Remand and Reconsultation ("Int. Rem. Findings"), *NRDC v. Kempthorne*, Doc. 561 (Dec. 14, 2007).<sup>1</sup>

<sup>1</sup> There is limited merit to Plaintiffs' contention that these prior findings are "not relevant." See

Doc. 551 at 91. These findings are not dispositive, but cannot be ignored, as they are based on extensive scientific testimony subject to cross-examination by many of the Plaintiffs in the present case. The order remanded the 2005 BiOp back to FWS "for further consideration consistent with [the] Court's orders and the requirements of law." Int. Rem. Order at 2 (emphasis added).

Reclamation and DWR were ordered, among other things, to implement a winter "pulse flow" in OMR of no more negative than -2,000 cubic feet per second ("cfs"), and to "operate the CVP and SWP to achieve a daily average net upstream (reverse) flow in the OMR not to exceed 5,000 cfs on a seven-day running average" during a defined period in the spring. Int. [\*864] Rem. Order at 5-7; *see also* Int. Rem. Findings at 15-20.

FWS issued a new delta smelt biological opinion on December 15, 2008 ("2008 Smelt BiOp" or "BiOp"). *See* Administrative Record [\*\*13] ("AR") at 00001-00411.<sup>2</sup> This BiOp concluded that proposed CVP and SWP operations are "likely to jeopardize the continued existence of" the delta smelt and "adversely modify" its critical habitat. BiOp at 276-79. The BiOp includes a required Reasonable and Prudent Alternative ("RPA") designed to allow the projects' continued operations without causing jeopardy to the species or adverse modification to its critical habitat. *Id.* at 279-85. The RPA includes operational components designed to reduce entrainment of smelt during critical times of the year by controlling (limiting) water exports from the Delta by the Projects. *Id.* at 279-85.

2 Citations to the 2008 delta smelt BiOp will be to the BiOp's original pagination, not Administrative Record page numbers.

Component 1, to protect of the adult delta smelt life stage, consists of two Actions related to OMR flows.

o Action 1, to protect upmigrating delta smelt, is triggered during low and high entrainment risk periods based on physical and biological monitoring. Action 1 requires OMR flows to be no more negative than -2,000 cfs on a 14-day average and no more negative than -2,500 cfs for a 5-day running average. *Id.* at 280-82, 329-51.

o Action [\*\*14] 2, to protect adult delta smelt that have migrated upstream and are present in the Delta prior to spawning. Action 2 is triggered immediately after Action 1 concludes or if recommended by the Smelt Working Group

("SWG"). Flows under Action 2 can be set within a range from -5,000 to -1,250 cfs, depending on a complex set of biological and environmental parameters. *Id.* at 281-82, 352-56.

Component 2 (Action 3), to protect larval and juvenile delta smelt, requires OMR flows to be kept between -1,250 and -5,000 cfs, after Component 1 is completed, when Delta water temperatures reach 12 Celcius ("C"), or when a spent female smelt is detected in trawls or at salvage<sup>3</sup> facilities. *Id.* at 282, 357-58. Component 2 continues until June 30 or when the Clifton Court Forebay water temperature reaches 25 C. *Id.* at 282, 368.

3 It is undisputed that Project pumping "kills Delta smelt by sucking them directly into the pumps; by drawing them into fish 'salvage' facilities which collect fish diverted from entering the pumps, a process that kills the smelt; and drawing smelt into the SWP's Clifton Court Forebay from which the fish cannot escape and where they will die even if they are not drawn into the [\*\*15] salvage facilities or the pumps." Int. Rem. Findings ¶ 19.

Component 3 (Action 4), to improve habitat for delta smelt growth and rearing, requires sufficient Delta outflow to maintain average mixing point locations of Delta outflow and estuarine water inflow ("X2"<sup>4</sup>) from September to December, depending on water year type, in accordance with a specifically described "adaptive management process" overseen by FWS. *Id.* at 282-83, 369.<sup>5</sup>

4 X2 is the location in the Delta where the salinity is two parts per thousand, measured as the distance upstream from the Golden Gate. *Consolidated Delta Smelt Cases*, 717 F. Supp. 2d 1021, 1029 (E.D. Cal. May 27, 2010); BiOp at 149.

5 Action 5, which is not formally associated with any "Component" of the RPA, prohibits FWS from installing the Head of Old River Barrier, a physical barrier designed to reduce the number of out-migrating salmon smolts entering Old River, in the spring if delta smelt entrainment triggers are met. BiOp at 175, 377-78.

[\*865] Component 4 (Action 6) (Habitat Restoration), requires DWR to create or restore 8,000 acres of intertidal and subtidal habitat in the Delta and Suisun Marsh within 10 years. *Id.* at 283-84, 379.

Component 5 (Monitoring [\*\*16] and Reporting), requires Reclamation and DWR to gather and report in-

formation to ensure proper implementation of the RPA actions, achievement of physical results, and evaluation of the effectiveness of the actions on the targeted life stages of delta smelt, so that the actions can be refined, if needed. *Id.* at 284-85, 328, 375.

The first of the six consolidated challenges to the BiOp was filed on March 3, 2009. Doc. 1. Plaintiffs moved for a preliminary injunction on April 24, 2009 to prevent Reclamation from implementing Component 2 of the RPA, alleging that FWS violated the National Environmental Policy Act ("NEPA") and the ESA. *See* Doc. 31.

On May 22, 2009, the Court granted that motion in part, finding that Plaintiffs were likely to succeed on the merits of their NEPA claim and requiring FWS to make specific written findings to justify OMR flow restrictions. *See* Doc. 84; *see also* Doc. 94, Findings re Mot. for Prelim. Inj. (May 29, 2009). Defendants complied with that Order, submitting weekly notices of FWS's OMR flow decisions. *See, e.g.*, Doc. 111, Notice of OMR Flow Decision (June 11, 2009). The Court's May 2009 preliminary injunction ruling was not based on Plaintiffs' ESA claims. [\*17] Doc. 94 at 43.

Plaintiffs amended their Complaint, joined and added claims against Reclamation, *see* Doc. 292, and moved for summary judgment on their NEPA claim, *see* Doc. 245. A November 13, 2009, ruling granted summary adjudication in part, based on Reclamation's failure to prepare an environmental impact statement before provisionally accepting and implementing the BiOp and its RPA Actions. Doc. 399.

Summary judgment for Defendants was granted on: (1) Stewart and Jasper Orchards' *Commerce Clause* claim that the ESA did not apply to protect delta smelt, a purely intra-state species, Doc. 339; and (2) claims that the BiOp violated regulations governing formulation of the RPA by not including required information in the BiOp text, Doc. 354.

Plaintiffs then filed three temporary restraining order motions over a six week period -- all of which were denied. *See* Docs. 555 & 583; *see also* 3/16/10 Hrg. Tr. at 86-88. Plaintiffs next sought a preliminary injunction against implementation of RPA Component 3. An evidentiary hearing was held from April 2, 2010 through April 7, 2010. Docs. 644, 652-54. Findings Re Plaintiffs' Request for Preliminary Injunction issued May 27, 2010 ("PI Decision"). Doc. [\*18] 704. The PI Decision confirmed Plaintiffs had succeeded on their NEPA claim and found Plaintiffs were likely to succeed on the merits of their ESA claim:

Although the premise underlying Component 2 -- that the species may be jeop-

ardized by increased negative flows occasioned by export pumping -- has record support, FWS has failed to adequately justify by generally recognized scientific principles the precise flow prescriptions imposed by Component 2. The exact restrictions imposed, which are inflicting material harm to humans and the human environment, are not supported by the record, making it impossible to determine whether RPA Component 2 [is] overly protective. Judicial deference is not owed to arbitrary, capricious, and scientifically unreasonable agency action.

[\*866] *Id.* at 122. Plaintiffs presented evidence under NEPA on the balance of the hardships that social dislocation, unemployment, and other threats to human health and safety were caused by interdiction of Plaintiffs' water supply. *See id.* at 123. Countervailing irreparable harm was found, because "the species and its critical habitat[] are entitled to protection under the ESA." *Id.* at 124. Acknowledging the existence of legal and [\*19] equitable grounds for injunctive relief, further evidence was requested on the "status of the species to assure that altered operations will not deepen jeopardy to the affected species or otherwise violate other laws." *Id.* at 125. Specifically, to establish "that Plaintiffs' proposed remedy of a flat -5,600 cfs ceiling on negative OMR flows will not jeopardize the continued existence of the species and/or adversely modify its critical habitat." *Id.*

A May 28, 2010 status conference sought to determine whether a mutually-agreeable interim operational plan could be implemented. Doc. 706. On June 22, 2010, the parties stipulated to a joint operational plan to maintain OMR flows so as not to be more negative than -5,000 cfs, unless certain, defined salvage triggers required a further reduction in OMR flows. Doc. 724.

After these dispositive motions were filed, the National Academy of Sciences, completed a comprehensive review of the BiOp, and concluded that the BiOp and the RPA Actions were "scientifically justified." *See* National Academy of Sciences, National Research Council, A Scientific Assessment of Alternatives for Reducing Water Management Effects on Threatened and Endangered Fishes in California's Bay Delta at 3. [\*20] Doc. 635. This post-decisional document is not part of the Administrative Record ("AR") and no legal justification exists to supplement the AR to include it.

Additionally, a scientific peer review panel was convened by the private consulting firm, Post Buckley Shuh and Jernigan ("PBS&J"), at the request of Plaintiff

Family Farm Alliance ("FFA") in connection with FFA's administrative petition under the Information Quality Act ("IQA"). See *Family Farm Alliance v. Salazar*, 09-cv-1201 OWW-DLB (E.D. Cal.), Doc. 27, Ex. A. This document is part of the administrative record in the *Family Farm Alliance* IQA case, not the smelt AR. There is no basis to consider this document for non-IQA claims.

### III. STATUS OF THE SPECIES

The delta smelt was listed as a threatened species under the ESA on March 5, 1993. 58 Fed. Reg. 12,854 (March 5, 1993). Critical habitat was designated for the delta smelt on December 19, 1994. 59 Fed. Reg. 65,256 (Dec. 19, 1994). Once an abundant species in the Bay-Delta ecosystem as recently as thirty years ago, the delta smelt is now in imminent danger of extinction. PI Decision, Finding of Fact ¶ 10. All the evidence shows a significant decline in smelt abundance since 2000, [\*\*21] recently up to three orders of magnitude below historic lows. *Id.* The latest fall mid-water trawl ("FMWT") abundance index for the species was 17, the lowest level ever recorded. *Id.*

On April 7, 2010, FWS announced that reclassifying the delta smelt from a threatened to an endangered species was warranted, but precluded by higher priority listing actions. 75 Fed. Reg. 17,667 (Apr. 7, 2010). The direct mortality of delta smelt by entrainment at the CVP-SWP pumps, as well as the destruction and adverse modification of its habitat in the Delta caused by water exports, were important factors in this determination. *Id.* at 17,669, 17,671 ("The operation of State and Federal export facilities constitute a [\*867] significant and ongoing threat to delta smelt through direct mortality by entrainment"). As a result of the "immediate and high magnitude threats" confronting the species, the delta smelt was assigned a listing priority number of 2. <sup>6</sup> *Id.* at 17,675.

6 "Warranted but precluded" species are assigned listing priority-numbers from 1 to 12, with 1 being the highest priority. *Id.* at 17,674.

### IV. SUMMARY OF MOTION

#### A. Plaintiffs' Motion.

Plaintiffs' motion advances the following grounds and contentions:

- (1) [\*\*22] FWS failed to rely on the "best available science" by making fundamental scientific errors in its analysis of the impacts of Project Operations on the species by:

- (a) Relying on raw salvage numbers in quantitative impact analyses;

- (b) Failing to conduct a life cycle analysis;

- (c) Comparing the results of two entirely different, incompatible flow and salinity models; and

- (d) Selectively excluding certain data for one purpose, but then unjustifiably using it for another;

(2) The BiOp's Project Effects Analysis is arbitrary and capricious because FWS:

- (a) Assumed that Project operations drive hydrological conditions in the Delta and did not explain or justify this attribution;

- (b) Evaluated the impacts of other (i.e., non-Project) stressors erroneously and inconsistently; and

- (c) Improperly characterized summer food supply suppression, invasive species, and pollution and contaminants as indirect effects of Project Operations;

(3) The BiOp is arbitrary and capricious because it does not distinguish between discretionary and nondiscretionary actions, improperly inflating the alleged effects of Project Operations;

(4) The BiOp's RPA is unlawful because FWS did not conduct the specific analyses required [\*\*23] by the ESA and FWS' own RPA regulation, 50 C.F.R. § 402.02, because neither the BiOp nor the AR demonstrate that FWS analyzed or applied the first three (of four) § 402.02 factors;

(5) FWS illegally arrogated to itself Project operating authority in derogation of Reclamation and DWR;

(6) FWS acted arbitrarily and capriciously by disregarding the Information Quality Act ("IQA") when preparing and issuing the BiOp;

(7) FWS violated NEPA by not considering the environmental impacts of issuing the BiOp and RPA.

(8) Reclamation violated its legal duties by accepting FWS' inherently flawed BiOp.

years 2006 through 2008, which predicts the ITS will likely be exceeded in half of all years. Second, FWS erroneously misapplied its own data with the result that the BiOp claims that the ITS was only exceeded in five of the previous sixteen years, rather than accurately stating that it was exceeded in eleven of the sixteen years. Third, the ITS take estimate is based on a data sample that is too small to provide a reasonable prediction of take under the RPA. These defects violate the ESA's "best [\*\*25] available science" requirement, the ESA's ITS requirements, and the APA.

#### B. DWR's Motion.

DWR's attacks three aspects of the BiOp:

(1) By relying on a comparison of CALSIM II model runs with what the BiOp terms "historic" data (which was actually generated by the Dayflow model), the BiOp's analysis of the effects of the proposed action on smelt habitat does not yield meaningful information and violates the ESA's best available science requirement. This analysis further violates the APA because FWS did not adequately articulate any rational connection [\*868] between the facts found based on these comparisons, and its conclusions regarding the Projects' effects on the smelt.

(2) Component [\*\*24] 3 of the RPA, also referred to in the BiOp as Action 4, is intended to mitigate the effects of the proposed action on smelt habitat, by requiring the Projects to maintain X2 in specified locations, depending on the type of water year. The BiOp, however, lacks sufficient explanation as to the basis for the specific prescriptions imposed by this Component, in violation of the APA. Moreover, to the extent that the record reveals that these prescriptions are based, even in part, on the methods used in the effects analysis, they violate the ESA's "best available science" mandate.

(3) The Incidental Take Statement ("ITS") is defective. First, its estimates are based on the average take from water

#### V. STANDARD OF DECISION

Summary judgment is appropriate when the pleadings and the record demonstrate that "there is no genuine dispute as to any material fact and that the moving party is entitled to judgment as a matter of law." *Fed. R. Civ. P. 56(c)*. The claims in this case involve FWS's issuance of a biological opinion, which is a final agency action subject to judicial review under the APA, 5 U.S.C. § 702. *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 524 F.3d 917, 925 (9th Cir. 2008) ("*NWF v. NMFS II*"). A court conducting judicial review under the APA may not resolve factual questions, but instead determines "whether or not as a matter of law the evidence in the administrative record permitted the agency to make the decision it did." *Sierra Club v. Mainella*, 459 F. Supp. 2d 76, 90 (D.D.C. 2006) (quoting *Occidental Eng'g Co. v. INS*, 753 F.2d 766, 769 (9th Cir. 1985)). "[I]n a case involving review of a final agency action under the [APA] ... the standard set forth in *Rule 56(c)* does not apply because of the limited role of a court in reviewing the administrative record." *Id.* at 89. In this context, [\*\*26] summary judgment becomes the "mechanism for deciding, as a matter of law, whether the agency action is supported by the administrative record and otherwise consistent with the APA standard of review." *Id.* at 90.

#### VI. BASIC LEGAL FRAMEWORK

##### A. Review under the APA.

Administrative Procedure Act ("APA") invalidation of a biological opinion requires Plaintiffs to prove that FWS's action was "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." 5 U.S.C. § 706(2)(A).

## (1) Record Review.

APA review of a biological opinion is "based upon the evidence contained in the administrative record." *Arizona Cattle Growers' Ass'n v. FWS*, 273 F.3d 1229, 1245 [\*869] (9th Cir. 2001). Judicial review under the APA must focus on the administrative record already in existence, not some new record made initially in a reviewing court. Parties may not use "post-decision information as a new rationalization either for sustaining or attacking the agency's decision." *Ass'n of Pac. Fisheries v. EPA*, 615 F.2d 794, 811-12 (9th Cir. 1980). Exceptions to administrative record review for technical information or expert explanation make such evidence admissible only for limited purposes, and those [\*\*27] exceptions are narrowly construed and applied. *Lands Council v. Powell*, 395 F.3d 1019, 1030 (9th Cir. 2005).

Here, as evidentiary rulings explained, *see, e.g.*, Docs. 387, 392 (10/19/09 Hrg. Tr), 406, 407, 462, 740 (7/8/10 Hrg.), 750, expert testimony has been considered only for explanation of technical terms and complex scientific subject matter beyond the Court's knowledge; and to understand the agency's explanations, or lack thereof, and the parties' arguments.

## (2) Deference to Agency Expertise.

A Court must defer to the agency on matters within the agency's expertise, unless the agency completely failed to address some factor, consideration of which was essential to making an informed decision. *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 422 F.3d 782, 798 (9th Cir. 2005) ("*NWF v. NMFS I*"). A court "may not substitute its judgment for that of the agency concerning the wisdom or prudence of the agency's action." *River Runners for Wilderness v. Martin*, 593 F.3d 1064, 1070 (9th Cir. 2009):

In conducting an APA review, the court must determine whether the agency's decision is "founded on a rational connection between the facts found and the choices made ... and whether [the agency] [\*\*28] has committed a clear error of judgment." *Ariz. Cattle Growers' Ass'n v. U.S. Fish & Wildlife*, 273 F.3d 1229, 1243 (9th Cir. 2001). "The [agency's] action ... need be only a reasonable, not the best or most reasonable, decision." *Nat'l Wildlife Fed. v. Burford*, 871 F.2d 849, 855 (9th Cir. 1989).

*Id.*

Although deferential, judicial review under the APA is designed to "ensure that the agency considered all of the relevant factors and that its decision contained no clear error of judgment." *Arizona v. Thomas*, 824 F.2d 745, 748 (9th Cir. 1987) (internal citations omitted). "The deference accorded an agency's scientific or technical expertise is not unlimited." *Brower v. Evans*, 257 F.3d 1058, 1067 (9th Cir. 2001) (internal citations omitted).

[An agency's decision is] arbitrary and capricious if [it] has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.

*Motor Vehicle Mfrs. Ass'n of U.S. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43, 103 S. Ct. 2856, 77 L. Ed. 2d 443 (1983); [\*\*29] *see also Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 416, 91 S. Ct. 814, 28 L. Ed. 2d 136 (1971) (reviewing court may overturn an agency's action as arbitrary and capricious if the agency failed to consider relevant factors, failed to base its decision on those factors, and/or made a "clear error of judgment"), *overruled on other grounds by Califano v. Sanders*, 430 U.S. 99, 105, 97 S. Ct. 980, 51 L. Ed. 2d 192 (1977)).

More generally, "[u]nder the APA 'the agency must examine the relevant data and articulate a satisfactory explanation [\*\*870] for its action including a rational connection between the facts found and the choice made.'" *Humane Soc. of U.S. v. Locke*, 626 F.3d 1040, 2010 U.S. App. LEXIS 24047, 2010 WL 4723195, \*5 (9th Cir. 2010) (quoting *Motor Vehicle Mfrs. Ass'n*, 463 U.S. at 43). "The reviewing court should not attempt itself to make up for an agency's deficiencies: We may not supply a reasoned basis for the agency's action that the agency itself has not given." *Id.*

## (3) General Obligations Under the ESA.

ESA Section 7(a)(2) prohibits agency action that is "likely to jeopardize the continued existence" of any endangered or threatened species or "result in the destruction or adverse modification" of its critical habitat. 16 U.S.C. § 1536(a)(2).

To "jeopardize [\*\*30] the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the

likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." 50 C.F.R. § 402.02; see also *NWF v. NMFS II*, 524 F.3d 917 (rejecting agency interpretation of 50 C.F.R. § 402.02 that in effect limited jeopardy analysis to survival and did not realistically evaluate recovery, thereby avoiding an interpretation that reads the provision "and recovery" entirely out of the text). An action is "jeopardizing" if it keeps recovery "far out of reach," even if the species is able to cling to survival. *NWF v. NMFS II*, 524 F.3d at 931. "[A]n agency may not take action that will tip a species from a state of precarious survival into a state of likely extinction. Likewise, even where baseline conditions already jeopardize a species, an agency may not take action that deepens the jeopardy by causing additional harm." *Id.* at 930.

To satisfy this obligation, the federal agency undertaking the action (the "action agency") must prepare a "biological assessment" that evaluates the [\*\*31] action's potential impacts on species and species' habitat. 16 U.S.C. § 1536(c); 50 C.F.R. § 402.12(a). If the proposed action "is likely to adversely affect" a threatened or endangered species or adversely modify its designated critical habitat, the action agency must engage in "formal consultation" with FWS to obtain its biological opinion as to the impacts of the proposed action on the listed species. See 16 U.S.C. § 1536(a)(2), (b)(3); see also 50 C.F.R. § 402.14(a), (g). Once the consultation process has been completed, FWS must give the action agency a written biological opinion "setting forth [FWS's] opinion, and a summary of the information on which the opinion is based, detailing how the agency action affects the species or its critical habitat." 16 U.S.C. § 1536(b)(3)(A); see also 50 C.F.R. § 402.14(h).

If FWS determines that jeopardy or destruction or adverse modification of critical habitat is likely, FWS "shall suggest those reasonable and prudent alternatives which [it] believes would not violate subsection (a)(2) of this section and can be taken by the Federal agency or applicant in implementing the agency action." 16 U.S.C. § 1536(b)(3)(A). "Following the issuance of [\*\*32] a 'jeopardy' opinion, the agency must either terminate the action, implement the proposed alternative, or seek an exemption from the Cabinet-level Endangered Species Committee pursuant to 16 U.S.C. § 1536(e)." *Nat'l Ass'n of Home Builders v. Defenders of Wildlife*, 551 U.S. 644, 652, 127 S. Ct. 2518, 168 L. Ed. 2d 467 (2008).

#### (4) Best Available Science.

Under the ESA, an agency's actions must be based on "the best scientific [\*\*871] and commercial data available." 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(g)(8) ("In formulating its Biological Opinion, any

reasonable and prudent alternatives, and any reasonable and prudent measures, the Service will use the best scientific and commercial data available....". A failure by the agency to utilize the best available science is arbitrary and capricious. See *Pac. Coast Fed'n of Fishermen's Assns. v. Gutierrez*, 606 F. Supp. 2d 1122, 1144 (E.D. Cal. 2008).

"The obvious purpose of the [best available science requirement] is to ensure that the ESA not be implemented haphazardly, on the basis of speculation or surmise." *Bennett v. Spear*, 520 U.S. 154, 176, 117 S. Ct. 1154, 137 L. Ed. 2d 281 (1997).

While this no doubt serves to advance the ESA's overall goal of species preservation, we think it readily apparent that another objective [\*\*33] [of the best available science requirement] (if not indeed the primary one) is to avoid needless economic dislocation produced by agency officials zealously but unintelligently pursuing their environmental objectives. That economic consequences are an explicit concern of the ESA is evidenced by § 1536(h), which provides exemption from § 1536(a)(2)'s no-jeopardy mandate where there are no reasonable and prudent alternatives to the agency action and the benefits of the agency action clearly outweigh the benefits of any alternatives. We believe the "best scientific and commercial data" provision is similarly intended, at least in part, to prevent uneconomic (because erroneous) jeopardy determinations.

*Id.* at 176-77.

A decision about jeopardy must be made based on the best science available at the time of the decision; the agency cannot wait for or promise future studies. See *Ctr. for Biological Diversity v. Rumsfeld*, 198 F. Supp. 2d 1139, 1156 (D. Ariz. 2002). The "best available science" mandate of the ESA sets a basic standard that "prohibits the [agency] from disregarding available scientific evidence that is in some way better than the evidence [it] relies on." *Am. Wildlands v. Kempthorne*, 530 F.3d 991, 998, 382 U.S. App. D.C. 78 (D.C. Cir. 2008) [\*\*34] (citation omitted).

What constitutes the "best" available science implicates core agency judgment and expertise to which Congress requires the courts to defer; a court should be especially wary of overturning such a determination on review. *Baltimore Gas & Elec. Co. v. Natural Res. Defense*

*Council*, 462 U.S. 87, 103, 103 S. Ct. 2246, 76 L. Ed. 2d 437 (1983) (a court must be "at its most deferential" when an agency is "making predictions within its area of special expertise, at the frontiers of science"). As explained in the *en banc* decision in *Lands Council*, 537 F.3d at 993, courts may not "impose on the agency their own notion of which procedures are best or most likely to further some vague, undefined public good." In particular, an agency's "scientific methodology is owed substantial deference." *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 378 F.3d 1059, 1066 (9th Cir. 2004).

When specialists express conflicting views, an agency must have discretion to rely on the reasonable opinions of its own qualified experts even if, as an original matter, a court might find contrary views more persuasive." *Lands Council*, 537 F.3d at 1000 (quoting *Marsh v. Oregon Natural Res. Council*, 490 U.S. 360, 378, 109 S. Ct. 1851, 104 L. Ed. 2d 377 (1989)). Mere [\*\*35] uncertainty, or the fact that evidence may be "weak," is not fatal to an agency decision. *Greenpeace Action v. Franklin*, 14 F.3d 1324, 1337 (9th Cir. 1992) (upholding biological opinion, despite uncertainty about the effectiveness of management [\*\*872] measures, because decision was based on a reasonable evaluation of all available data); *Nat'l Wildlife Fed'n v. Babbitt*, 128 F. Supp. 2d 1274, 1300 (E.D. Cal. 2000) (holding that the "most reasonable" reading of the best scientific data available standard is that it "permits the [FWS] to take action based on imperfect data, so long as the data is the best available"). FWS "must utilize the 'best scientific ... data available,' not the best scientific data possible." *Building Indus. Ass'n v. Norton*, 247 F.3d 1241, 1246, 345 U.S. App. D.C. 426 (D.C. Cir. 2001), cited with approval in *Kern County Farm Bureau v. Allen*, 450 F.3d 1072, 1080-81 (9th Cir. 2006) ("Absent superior data occasional imperfections do not violate" the ESA best available data standard); see also *Defenders of Wildlife v. Babbitt*, 958 F. Supp. 670, 680 (D.D.C. 1997) (best available science standard does not require "conclusive evidence," only that agency use best science available and not ignore contrary [\*\*36] evidence).

The deference afforded under the best available science standard is not unlimited. For example, *Tucson Herpetological Society v. Salazar*, 566 F.3d 870, 879 (9th Cir. 2009), held that an agency may not rely on "ambiguous studies as evidence" to support findings made under the ESA. Because the studies did not lead to the conclusion reached by FWS, the Ninth Circuit held that these studies provided inadequate support in the administrative record for the determination made by FWS. *Id.*; see also *Rock Creek Alliance v. U.S. Fish & Wildlife Service*, 390 F. Supp. 2d 993, 1008 (D. Mont. 2005) (rejecting FWS's reliance on a disputed scientific report,

which explicitly stated its analysis was not applicable to the small populations addressed in the challenged opinion). Alternatively, the presumption of agency expertise may be rebutted if the agency's decisions, although based on scientific expertise, are not reasoned, *Greenpeace v. NMFS*, 80 F. Supp. 2d 1137, 1147 (W.D. Wash. 2000), or if the agency disregards available scientific evidence better than the evidence on which it relies, *Kern County Farm Bureau*, 450 F.3d at 1080.

Courts routinely perform substantive reviews of record evidence [\*\*37] to evaluate the agency's treatment of best available science. The judicial review process is not one of blind acceptance. See, e.g., *Kern County*, 450 F.3d at 1078-79 (thoroughly reviewing three post-comment studies and FWS's treatment of those studies to determine whether they "provide[d] the sole, essential support for" or "merely supplemented" the data used to support a listing decision); *Home Builders Ass'n of N. Cal. v. U.S. Fish and Wildlife Serv.*, 529 F. Supp. 2d 1110, 1120 (N.D. Cal. 2007) (examining substance of challenge to FWS's determination that certain data should be disregarded); *Trout Unlimited v. Lohn*, 645 F. Supp. 2d 929 (D. Or. 2007) (finding best available science standard had been violated after thorough examination of rationale for NMFS's decision to withdraw its proposal to list Oregon Coast Coho salmon); *Oceana, Inc. v. Evans*, 384 F. Supp. 2d 203, 217-18 (D.D.C. 2005) (carefully considering scientific underpinnings of challenge to FWS's use of a particular model, including post decision evidence presented by an expert to help the court understand the complex model, applying one of several record review exceptions articulated in *Esch v. Yeutter*, 876 F.2d 976, 991, 278 U.S. App. D.C. 98 (D.C. Cir. 1989), [\*\*38] which are similar to those articulated by the Ninth Circuit).

Courts are not required to defer to an agency conclusion that runs counter to that of other agencies or individuals with specialized expertise in a particular technical area. See, e.g., *Am. Tunaboat Ass'n v. Baldrige*, 738 F.2d 1013, 1016-17 (9th Cir. 1984) (NMFS's decision under the [\*\*873] Marine Mammal Protection Act was not supported by substantial evidence because agency ignored data that was product of "many years' effort by trained research personnel"); *Sierra Club v. U.S. Army Corps of Eng'rs*, 701 F.2d 1011, 1030 (2d Cir. 1983) ("court may properly be skeptical as to whether an EIS's conclusions have a substantial basis in fact if the responsible agency has apparently ignored the conflicting views of other agencies having pertinent experience[") (internal citations omitted). A court should "reject conclusory assertions of agency 'expertise' where the agency spurns unrebutted expert opinions without itself offering a credible alternative explanation." *N. Spotted Owl v. Ho-*

*del*, 716 F. Supp. 479, 483 (W.D. Wash. 1988) (citing *Am. Tunaboat Ass'n*, 738 F.2d at 1016).

In *Conner v. Burford*, 848 F.2d 1441, 1453-54 (9th Cir. 1988), the [\*\*39] agency attempted to defend its biological opinions by arguing that there was a lack of sufficient information to perform additional analysis. In rejecting this defense, the Ninth Circuit held that "incomplete information ... does not excuse the failure to comply with the statutory requirement of a comprehensive biological opinion using the best information available," and noted that FWS could have completed more analysis with the information that was available. *Id.* at 1454.

In light of the ESA requirement that the agencies use the best scientific and commercial data available ... the FWS cannot ignore available biological info or fail to develop projections of ... activities which may indicate potential conflicts between development and the preservation of protected species. We hold that the FWS violated the ESA by failing to use the best information available to prepare comprehensive biological opinions.

*Id.* (emphasis added).

#### (5) Best Available Science Standards and the Application of Analytical/Statistical Methodologies.

The above-described standards apply with equal force to the use and interpretation of statistical methodologies. As the D.C. Circuit in *Appalachian Power Co. v. EPA*, 135 F.3d 791, 328 U.S. App. D.C. 379 (D.C. Cir. 1998), [\*\*40] explained in reviewing a challenge to a decision of the Environmental Protection Agency ("EPA") under the "arbitrary and capricious" standard of review:

Statistical analysis is perhaps the prime example of those areas of technical wilderness into which judicial expeditions are best limited to ascertaining the lay of the land. Although computer models are "a useful and often essential tool for performing the Herculean labors Congress imposed on EPA in the Clean Air Act," [citation] their scientific nature does not easily lend itself to judicial review. Our consideration of EPA's use of a regression analysis in this case must therefore comport with the deference traditionally given to an agency when reviewing a scientific analysis within its area of expertise with-

out abdicating our duty to ensure that the application of this model was not arbitrary.

*Id.* at 802.

The model must fit the available data. *See Nat'l Wildlife Fed'n v. EPA*, 286 F.3d 554, 565, 351 U.S. App. D.C. 42 (D.C. Cir. 2002) ("*NWF v. EPA*") (a court will only reject the choice of a model "when the model bears no rational relationship to the characteristics of the data to which it was applied"). For example, *Oceana*, 384 F. Supp. at 220, rejected a [\*\*41] challenge to NMFS's use of a particular analytical model that used data drawn from existing literature, even though experts [\*\*874] "suggested that reliable take limits cannot be established without quantitative data gathered from 'in-water' surveys." Although NMFS conceded "a thorough quantitative analysis based on empirical estimates of population size would be a superior way to analyze the impact [] on [the species]," it was undisputed that "given the paucity of information on sea turtles and the difficulties of using the data that does exist, '[a] different or more complex model [than that used by NMFS] was not available and could not even be constructed.'" *Id.* Likewise, "the fact that a given model has some imperfections does not prevent it from constituting the 'best scientific information available.'" *Oceana v. Evans*, 2005 U.S. Dist. LEXIS 3959, 2005 WL 555416, \*16-\*17 (D.D.C. Mar. 9, 2005)(citing 16 U.S.C. § 1851(a)(2))(approving NMFS's use of a model despite known limitations, where it was the only model available and the agency supplemented its analysis with other sources to address areas where the model was unable to make accurate predictions).

## VII. ANALYSIS

### A. Challenges to the Effects Analysis & Related Challenges [\*\*42] to the RPA Actions.

#### (1) Legal Requirements for a Project Effects Analysis.

Under section 7(a)(2) of the ESA and the Joint Consultation Regulations, FWS must "[e]valuate the effects of the action and cumulative effects on the listed species or critical habitat." 50 C.F.R. § 402.14(g)(3). FWS must then "[f]ormulate its biological opinion as to whether the action, taken together with cumulative effects,<sup>7</sup> is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat." § 402.14(g)(4). The effects of the action are defined as:

the direct and indirect effects of an action on the species or critical habitat, to-

gether with the effects [\*875] of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline.

§ 402.02.

7 Cumulative effects are "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." 50 C.F.R. § 402.02.

The environmental baseline includes:

the past and present impacts of all Federal, State, or private actions and other [\*\*43] human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process.

*Id.* The baseline is described in FWS and NMFS's Joint Consultation Handbook \* as:

an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the action area. The environmental baseline is a "snapshot" of a species' health at a specified point in time. It does not include the effects of the action under review in the consultation.

Consultation Handbook 4-22.

8 FWS and NMFS issued their final Joint Endangered Species Handbook ("Handbook" or "Consultation Handbook") in 1999. 64 Fed. Reg. 31,285 (June 10, 1999). The entire Handbook is available at [http://www.fws.gov/endangered/esalibrary/pdf/esa section7 handbook.pdf](http://www.fws.gov/endangered/esalibrary/pdf/esa%20section7%20handbook.pdf).

Once the baseline, the "direct and indirect effects" of the action, and the "effects of other activities that are interrelated or interdependent with that action" are

[\*\*44] determined, 50 C.F.R. § 402.02, FWS then is required to consider whether, in light of the environmental baseline, the effects of the action, taken together with cumulative effects, are likely to jeopardize the continued existence of the listed species, 50 C.F.R. § 402.14(g).

[An] agency may not take action that will tip a species from a state of precarious survival into a state of likely extinction. Likewise, even where baseline conditions already jeopardize a species, an agency may not take action that deepens the jeopardy by causing additional harm.

....[The agency must] appropriately consider the effects of its actions "within the context of other existing human activities that impact the listed species." *ALCOA [v. Administrator, Bonneville Power Admin.]*, 175 F.3d [1156,] 1162 n. 6 [(9th Cir. 1999)](citing 50 C.F.R. § 402.02's definition of the environmental baseline). This approach is consistent with our instruction ... that "[t]he proper baseline analysis is not the proportional share of responsibility the federal agency bears for the decline in the species, but what jeopardy might result from the agency's proposed actions in the present and future human and natural contexts." [*PCFFA v. U.S. Bureau of Reclamation*], 426 F.3d [1082,] 1093 [(9th Cir. 2005)](emphasis [\*\*45] added).

*NWF v. NMFS II*, 524 F.3d at 930 (emphasis in original).

To jeopardize means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species." 50 C.F.R. § 402.02. The Consultation Handbook further provides that to "appreciably diminish the value: [means] to considerably reduce the capability of designated [critical habitat]." Consultation Handbook at 4-36. A related case found:

interpretation of "appreciably" to mean any "perceptible" effect would lead to irrational results, making any agency action that had any effects on a listed species a "jeopardizing" action. This is not the law, as such an interpretation conflicts with other provisions of the ESA that permit incidental take of listed species.

*PCFFA v. Gutierrez*, 1:06-cv-00245 OWW GSA, Doc. 367 at 23-24 (citing *16 U.S.C. 1536(b)(4), 1539(a)(1)(B)*).

(2) Best Available Science Challenges to the Effects Analysis and Related Challenges to the Justification Provided for the RPA Actions.

Plaintiffs argue that the project effects analysis is predicated upon scientific errors that render the BiOp and its conclusion that project [\*\*46] operations jeopardize the delta smelt arbitrary, capricious and an abuse of discretion:

The Project Effects Analysis is the heart of the section 7 consultation process, providing the basis for FWS' jeopardy and adverse modification determinations and for formulating the RPA. In this case, FWS began the Project Effects Analysis of the 2008 Smelt BiOp with a remarkable assumption: "The following analysis assumes that the proposed CVP/SWP operations affect delta smelt throughout the year either directly through entrainment or indirectly through influences on its food supply and habitat suitability." BiOp at 203 (AR 000218.) This assumption plainly violates the "best available science" required by the ESA. The science, including the reports that FWS purports to rely on, shows that OMR flows and entrainment do not have any statistically [\*\*876] significant effect on the delta smelt's population growth rate. Restricting flows has no effect on the delta smelt population's survival--such restrictions are a costly, but meaningless gesture. The same is true for [restrictions designed to control the position of] X2 [in the Fall].

Doc. 551 at 8.

Plaintiffs maintain that the best available science does not [\*\*47] support FWS' "assumption" that "CVP/SWP operations affect delta smelt throughout the year either directly through entrainment or indirectly through influences on its food supply and habitat suitability." BiOp at 203. Plaintiffs maintain that the science demonstrates:

(a) OMR flows have no statistically significant effect on the delta smelt population growth rate;

(b) With respect to the adult population, only OMR flows more negative than -6,100 cfs will correlate to an increase in entrainment;<sup>9</sup>

(c) The location of Fall X2 does not determine the extent and quality of suitable smelt habitat -- as with OMR flows, Fall X2 has no statistically significant effect on the population growth rate; and,

(d) The CVP/SWP projects do not indirectly govern abiotic and biotic factors in the Delta that affect delta smelt abundance.

Doc. 551 at 11. Plaintiffs also maintain that there is no scientific support for the BiOp's assumption that the Projects control hydrodynamic conditions in the Delta, or for the BiOp's classification of non-Project causes of harm as "indirect effects" of Project Operations. *Id.*

9 As this argument was supported exclusively by portions of the declaration of Dr. Richard B. Deriso [\*\*48] that have been stricken, Doc. 750 at ¶ 3, this argument cannot be considered.

a. The BiOp's General Conclusion that Entrainment by Project Operations Adversely Affects Smelt Survival & Recovery is Supported by the Record.

The magnitude of diversions at the CVP and SWP pumping facilities influences flows throughout the Delta, including in the Old and Middle Rivers ("OMR"). BiOp at 160. When the level of diversion at the pumps is high, Old and Middle Rivers may flow backwards (in the opposite direction than they would under natural hydrological conditions) and toward the CVP and SWP natural conditions (called "negative" flows). *Id.* Negative OMR flows draw delta smelt present in the central and south Delta toward the pumps, and high negative flows increase the risk that they will be entrained at the pumps. *Id.* at 163, 253 (Figure E-7)

Unlike larger fish species, entrainment is lethal for weak-swimming delta smelt. *Id.* at 145. Relying on estimates of proportional entrainment presented by Dr. Wim Kimmerer in a 2008 paper entitled "Losses of Sacramento River Chinook Salmon and Delta Smelt to Entrainment in Water Diversions in the Sacramento-San Joaquin Delta," published in the journal, San Francisco Estuary & Watershed Science ("Kimmerer

(2008)" ), the BiOp concludes that "[t]otal annual entrainment of the delta smelt population (adults and their progeny combined) ranged from approximately 10 percent to 60 percent per year from 2002-2006." *Id.* at 210. In years when low flows and high exports coincide with a spawning distribution of the delta smelt that includes the San Joaquin River, the loss of larval delta smelt due to entrainment can exceed 50% of the population. *Id.* at 164-65. Such losses do not occur every year, but FWS concluded the effect of these large larval loss events [\*877] is "substantial when it does," particularly in light of the fact that the delta smelt is an annual fish. *Id.* at 165. Even one year where its spawning occurs "within the footprint of entrainment by the pumps" can lead to "a [severe] reduction in that year's production." *Id.*

The BiOp's Effects Analysis concludes that Project pumping operations have a "sporadically significant" adverse effect on smelt abundance:

The population-level effects of delta smelt entrainment vary; delta smelt entrainment can best be characterized as a sporadically significant influence on population dynamics. Kimmerer (2008) [\*50] estimated that annual entrainment of the delta smelt population (adults and their progeny combined) ranged from approximately 10 percent to 60 percent per year from 2002-2006. Major population declines during the early 1980s (Moyle et al. 1992) and during the recent POD years (Sommer et al. 2007) were both associated with hydrodynamic conditions that greatly increased delta smelt entrainment losses as indexed by numbers of fish salvaged. However, currently published analyses of long-term associations between delta smelt salvage and subsequent abundance do not support the hypothesis that entrainment is driving population dynamics year in and year out (Bennett 2005; Manly and Chotkowski 2006; Kimmerer 2008).

BiOp at 210 (emphasis added). This passage was based in large part on Kimmerer (2008), which states:

Delta smelt may suffer substantial losses to export pumping both as pre-spawning adults and as larvae and early juveniles. In contrast to the situation for salmon, pre-salvage mortality has been constrained in the calculations for adult

Delta smelt, and its effects eliminated from the calculations for larval/juvenile Delta smelt. Combining the results for both life stages, losses may [\*51] be on the order of zero to 40 percent of the population throughout winter and spring. The estimates have large confidence limits, which could be reduced by additional sampling, particularly to estimate 0 in Equation 18. If there is interest in improving these estimates further, some attempts should be made to examine the assumptions not fully tested above, particularly those used in extrapolating larval abundance to hatch dates.

AR 018877.

Plaintiffs argue that the BiOp misinterprets and misapplies Kimmerer's work. Dr. Bryan Manly, Plaintiffs' expert in the fields of biostatistics and population survey design, addressed the BiOp's statement that "delta smelt entrainment can best be characterized as a sporadically significant influence on population dynamics." Manly Decl., Doc. 397, at ¶ 7. Manly opines that "[t]his statement is unclear and confusing," and explains:

If the Service meant only that abundance at a point in time during a single year may vary depending upon entrainment, then Kimmerer's estimates support that statement. But if, as appears more likely, the Service was relying upon Kimmerer's estimates to support a conclusion that entrainment sometimes causes abundance to vary [\*52] significantly later in the same year or in following years, then the statement in the BiOp has no scientific basis.

*Id.* Kimmerer (2008) only estimated percentage losses of delta smelt within single year classes, and did not conclude that such losses reduce population abundance from one year to the next. *Id.* at ¶ 8. In fact, Kimmerer (2008) contains a number of disclaimers, including the caveat that [\*878] "export effects" on smelt are small relative to other factors affecting survival:

Although the upper bound of [the 0-40% loss] range represents a substantial loss, the effect of this loss is complicated by subsequent variability in survival (Figure 17). If this variability is uncorrelated

with entrainment losses, then these losses will contribute little to the variability in fall abundance index. The simplest way to evaluate this is by regression of fall midwater trawl index on winter-spring export flow, but this relationship is contaminated by the downward step change in abundance in approximately 1981--1982, together with the long-term upward trend in export flow (mainly up to the mid-1970s, see Kimmerer 2004). Including this step in a regression model eliminates the effect of export flow [\*\*53] on the fall midwater trawl index (coefficient =  $-1.5 \pm 2.4$ , 95% CL, 36 df). It seems unlikely that the downward step change was due to the earlier increase in export flow; furthermore, despite substantial variability in export flow in years since 1982, no effect of export flow on subsequent midwater trawl abundance is evident.

This is not to dismiss the rather large proportional losses of delta smelt that occur in some years; rather, it suggests that these losses have effects that are episodic and that therefore their effects should be calculated rather than inferred from correlative analyses. In the absence of density dependence, using means in Figure 15 with natural mortality, fall abundance should have been reduced by ~10% during 1995-2005. This would have an equivalent effect of reducing the summer-fall survival index by 10%. This would have made little difference to fall abundance in the context of the approximately 50-fold variation in summer-fall survival (Figure 17), and would be difficult to detect through correlation.

Although summer-fall survival appears to dominate variability in abundance of delta smelt in fall (Figure 17), this does not imply that control of export effects [\*\*54] would be fruitless, as these effects can be considerable during dry years. Management of delta smelt should incorporate any opportunities that arise to improve habitat or food supply and to reduce any negative impacts of predation or toxic contamination. However, current evidence does not provide a clear path toward improving the status of delta smelt using these factors. Manipulating export flow (and, to some extent, inflow) is the only

means to influence [\*\*879] the abundance of delta smelt that is both feasible and supported by the current body of evidence, even though export effects are relatively small. The results presented here can be used to suggest when, and under what conditions, control of export effects would be most helpful.

AR 018878. Kimmerer (2008) concludes that even though correlative analysis revealed "no effect of export flow on subsequent midwater trawl abundance," there is reason to be concerned about episodic effects caused by "large proportional losses of delta smelt that occur in some years." *Id.* As a result, according to Kimmerer (2008), population level effects should be calculated, rather than inferred from correlative analysis. *Id.* After performing such a calculation, [\*\*55] Kimmerer (2008) concluded that entrainment reduced "the summer-fall survival index by ~10%" during 1995-2005. *Id.* Although this 10% figure was small in the context of the 50-fold variation in summer-fall survival, Kimmerer (2008) nonetheless recommended controlling export effects on smelt because "[m]anipulating export flow (and to some extent, inflow) is the only means to influence the abundance of delta smelt that is both feasible and supported by the current body of evidence, even though export effects are relatively small." *Id.* (emphasis added).

Dr. Manly is correct that Kimmerer (2008) does not support the position that entrainment has a "sporadically significant" effect on delta smelt abundance from one year to the next. However, contrary to Dr. Manly's suggestion, the BiOp does not rely on Kimmerer (2008) for this premise. The BiOp qualifies its reliance on Kimmerer (2008), consistent with the narrow scope of Kimmerer's findings:

The population-level effects of delta smelt entrainment vary; delta smelt entrainment can best be characterized as a sporadically significant influence on population dynamics. Kimmerer (2008) estimated that annual entrainment of the delta smelt population [\*\*56] (adults and their progeny combined) ranged from approximately 10 percent to 60 percent per year from 2002-2006. Major population declines during the early 1980s (Moyle et al. 1992) and during the recent POD years (Sommer et al. 2007) were both associated with hydrodynamic conditions that greatly increased delta smelt entrainment losses as indexed by numbers of fish sal-

vaged. However, currently published analyses of long-term associations between delta smelt salvage and subsequent abundance do not support the hypothesis that entrainment is driving population dynamics year in and year out (Bennett 2005; Manly and Chotkowski 2006; Kimmerer 2008).

BiOp at 210 (emphasis added). It was not unreasonable for FWS to rely on Kimmerer (2008) to conclude that salvage events may be "sporadically significant." Plaintiffs' argument that FWS misinterpreted Kimmerer (2008) is unfounded. Kimmerer (2008) explains why, despite the absence of a statistically significant correlation between export pumping and the subsequent year's smelt population (i.e., between export pumping and the population growth rate), the demonstrated "sporadically significant" loss of smelt within year classes could significantly [\*\*57] contribute to the species' jeopardy. FWS reasonably relied on Kimmerer (2008) for this finding.

Applying Kimmerer's estimates of entrainment and other data, the BiOp analyzed the effect Project operations have on the frequency of relatively large loss events. For larval and juvenile delta smelt:

Kimmerer (2008) proposed a method for estimating the percentage of the larval-juvenile delta smelt population entrained at Banks and Jones each year. These estimates were based on a combination of larval distribution data from the 20-mm survey, estimates of net efficiency in this survey, estimates of larval mortality rates, estimates of spawn timing, particle tracking simulations from DWR's DSM-2 particle tracking model, and estimates of Banks and Jones salvage efficiency for larvae of various sizes. Kimmerer estimated larval-juvenile entrainment for 1995-2005. We used Kimmerer's entrainment estimates to develop multiple regression models to predict the proportion of the larval-juvenile delta smelt population entrained based on a combination of X2 and OMR....

BiOp at 220. The BiOp predicts that "the proposed action will decrease the frequency of years in which estimated entrainment is [less than [\*\*58] or equal to] 15 percent. Thus, over a given span of years, the project as

proposed will increase larval-juvenile entrainment relative to 1995-2005 levels. This will have an adverse [\*880] effect on delta smelt based on their current low population levels." BiOp at 222.

For adult delta smelt:

The median OMR flows from the CAL-SIM II modeled scenarios were more negative than historic OMR flow for all WY types except critically dry years (Figure E-3; see Table E-5b for all differences). Overall, proposed OMR flows are likely to generate increases in population losses compared to historic years (Figure E-5 and Figure E-6). For example, the frequency of years when population losses are less than 10 percent from most modeled studies (except studies 7.0 and 8.0) is less than 24 percent compared to historic estimates that only exceed 10 percent in approximately half of the years.

The most pronounced differences occur during wet years, where median OMR flows are projected to be approximately 400 to 600 percent (-7100 to -3678 cfs) higher than historical wet years (-1032 cfs). Generally, wet years are marked by low salvage and population losses. However, the proposed operations during wet year are predicted [\*\*59] to cause up to a 65 percent increase in smelt salvage and lower probability that population losses will be below 10 percent.

The proposed operation conditions likely to have the greatest impact on delta smelt are those modeled during above normal WYs. The modeled OMR flows for the above normal WYs ranged between -8155 and -6242 cfs, a 33 to 57 percent decrease from the historic median of -5178 cfs. Though the predicted salvage would only be about 15-20 percent higher than historic salvage during these years (Table E-5c), the modeled OMR flows in these years would increase population losses compared to historic years.

In below normal and dry WYs, proposed OMR flows are also modeled to decrease from historic medians. Predicted salvage levels are likely to increase between 2 and 44 percent. More importantly, the modeled median flows from all studies in these WY types range between -

5747 and -7438 cfs. Modeled OMR flows at these levels are predicted to increase salvage and increase the population losses from historic levels as well.

During critically dry years, the median OMR flows for studies 7.0, 7.1, 8.0, 9.1, 9.4, and 9.5 are less than -5,000 cfs. These studies have predicted salvage [\*\*60] lower than historic salvage and are not likely to generate larger population losses compared to historic years. The models might overestimate salvage during critical dry years when smelt are unlikely to migrate towards the Central Delta due to lack of turbidity or first flush. Thus, the effects of critical dry operations on delta smelt take are probably small and lower than estimated.

In summary, adult entrainment is likely to be higher than it has been in the past under most operating scenarios, resulting in lower potential production of early life history stages in the spring in some years. While the largest predicted effects occur in Wet and Above Normal WYs, there are also likely adverse effects in Below Normal and Dry WYs. Only Critically Dry WYs are generally predicted to have lower entrainment than what has occurred in the recent past.

BiOp at 212-13.

This approach is consistent with Kimmerer (2008). The BiOp does not focus on whether there is a statistically significant correlation between OMR flows and the [\*\*881] population growth rate.<sup>10</sup> Rather, following Kimmerer (2008), the BiOp focuses on predicting the frequency of large salvage events and concluded that Project operations increase [\*\*61] their frequency. It was not arbitrary, capricious, or clear error for FWS to base its jeopardy conclusion in part on these predictions of relative increases in entrainment. *See* BiOp at 276.

10 FWS did rely on a study by Manly and Chotkowski that found a statistically significant correlation between OMR flows and smelt abundance, albeit a small one. *See* BiOp at 159 ("Manly and Chotkowski (2006; IEP 2005) found that monthly or semi-monthly measures of exports or Old and Middle rivers flow had a reliable, statistically significant effect on delta smelt abundance; however, individually they explained a small portion

(no more than a few percent) of the variability in the fall abundance index of delta smelt across the entire survey area and time period.").

#### b. Population Level Analysis/Life-Cycle Modeling.

Plaintiffs maintain the BiOp's failure to employ a life-cycle model ignored the best available science. Doc. 551 at 21-22. Using a quantitative<sup>11</sup> life-cycle model<sup>12</sup> is a recognized (the best) method to evaluate the effects of an action upon a fish population's growth rate. Dr. Richard B. Deriso<sup>13</sup> opined that a population growth rate analysis is the generally accepted method utilized by fisheries [\*\*62] biologists to evaluate the impact of a stressor on a fish species' population. Declaration of Dr. Richard B. Deriso, Doc. 401, at ¶ 36; *see also* Declaration of Dr. Ray Hilborn<sup>14</sup>, Doc. 393, at ¶¶ 7-16 (agreeing that life-cycle models are the accepted method in population dynamics to evaluate anthropogenic effects on the probability of growth or decline of a species); Declaration of Ken B. Newman<sup>15</sup>, Doc. 484, at ¶ 8 (agreeing with "utility of life history models for assessing population level effects of SWP/CVP operations."). Dr. Hilborn explained that a quantitative population dynamics/life cycle model can help distinguish human actions that have a significant impact on population size from those that have little impact on population size, because competition for a resource that is independent of the human activity may cause significant mortality at one stage in the species' life cycle, meaning that human actions that kill fish at that life stage may have little impact on the population level later in the life history. Hilborn Decl., Doc. 393 at ¶ 15.

11 The BiOp used a relatively simple, non-quantitative, conceptual life-cycle model. *See* BiOp at 203. It is undisputed that no quantitative [\*\*63] life cycle model was employed.

12 The experts use the term "population dynamics model," "life history model," and "life cycle model" interchangeably.

13 Dr. Deriso is an expert in the field of quantitative ecology and its application to fisheries management. Deriso Decl., Doc. 396, at ¶¶ 5-10.

14 Dr. Hilborn is an expert in aquatic and fishery sciences. Hilborn Decl., Doc. 393, at ¶ 1.

15 Dr. Newman is an expert in mathematical statistics employed by FWS in Stockton, California.

Federal Defendants knew of the value of life-cycle modeling. At a March 8, 2007 meeting on the OCAP ESA Re-consultation, attended by FWS employees, the importance of using a life cycle model was emphasized and inquiry made about the progress to date. AR 016016 - 016017. During the Delta Smelt Action Evaluation

Team meeting on August 8, 2008, that Team recognized that population models for delta smelt already had been developed, and that those models were a starting point for quantitative analyses when [\*882] combined with appropriate assumptions. AR 011381-011382; *see also* AR 010023, 010027-010029.

There is considerable dispute over whether an appropriate life-cycle model (i.e., one sufficient to perform the types of analyses [\*\*64] that would be helpful in the BiOp) existed at the time the BiOp issued. Dr. Newman declares:

Despite the utility of life history models and despite the information that the various surveys provide about different life history stages, an adequately realistic quantitative delta smelt life history model that has been fit using fish survey data does not exist. The BiOp did in many places (e.g., pp 146, 184, 203) consider the full life history of delta smelt but considerations were via conceptual models in contrast to quantitative models with parameters estimated from data. Part of the difficulty is that there are currently no off-the-shelf computational programs for fitting such a model to data and one must develop customized, computer intensive software. The need to model the spatial and temporal changes in population abundances and to account for the different sources of uncertainty makes model formulation and fitting complex. In particular, uncertainty in survey data, due to random sampling error and bias, complicates model fitting. Capture probabilities differ between surveys, the probabilities are largely unknown (despite efforts made to estimate them, for example, for FMWT data, see [\*\*65] Newman 2008 (Administrative Record "AR" at 19782-19799)), and capture and fish presence probabilities are thus confounded. Furthermore, given the patchiness and heterogeneity of the spatial and temporal distribution of delta smelt and the relatively low capture probabilities (whatever they might be), the sampling errors associated with survey data can be quite large (Newman 2008 (AR at 19782-19799)). Failure to account for sampling errors may result in biased parameter estimates (including wrongly concluding density dependence; Shenk et al. 1998). *The difficulties are not insurmountable, but concentrated research ef-*

*forts are required.* I know of three such efforts currently underway and at varying stages of development: (1) an individual-based model with a spatial component by Drs. Wim Kimmerer, San Francisco State University, William Bennett, University of California at Davis, Stephen Monismith, Stanford University, and Kenneth Rose, Louisiana State University; (2) a population-level life history model using information from multiple surveys by Dr. Mark Maunder, Inter American Tropical Tuna Commission; (3) similar to Maunder, a life history model with a spatial component based on multiple [\*\*66] surveys' data has been conceptually sketched by me and others in the NCEAS POD working group. Given sufficient time and appropriate technical resources, including personnel, to focus on model formulation and fitting, these models might be available within a year.

Newman Decl., Doc. 484 at ¶ 5.

All of the experts agreed with Dr. Newman that, at the time the BiOp was issued, there was no "off-the-shelf" life-cycle model to apply to delta smelt. Considerable dispute exists over how long it should have taken FWS to develop a competent model. It is undisputed that basic life-cycle models such as the Ricker model can be applied to fisheries data sets in relatively short order. Deriso Decl., Doc. 605, at ¶ 52. Dr. Deriso opined that FWS had all the data necessary to perform a life-cycle analysis. Deriso Decl., Doc. 401, at ¶ 70. Dr. Hilborn stated that a relatively complex life-cycle model that "follow[s] the size [\*883] structure of delta smelt through their life history and fit this into the observed size structure" would "require no more than a few months time to construct, evaluate and use in a biological opinion." Hilborn Decl., Doc. 600 at ¶ 14. Dr. Punt, a 706 Expert with expertise in fish [\*\*67] population dynamics and biostatistics, see Doc. 394 at 2, stated "[i]t is surprising that a population dynamics model was not developed for delta smelt for the BiOp.... The model developed by Bennett could have been extended to more fully account for the biology of delta smelt and fitted to data to assess the population-level effects of impact of the project." Doc. 633-1 at 3.

Federal Defendants' expert, Mr. Feyer disagrees:

Developing a quantitative population model is a challenging and complex exercise that could not have been completed

by USFWS within the timeframe required to issue the 2008 BiOp. The work requires a substantial investment of resources and individuals with very specialized skills. The process to develop, test, peer-review, and apply such models often takes years. For instance ... the development of models for Columbia River salmon ... took no less than three years to complete.

Because of the recognized urgent need for such tools, there are on-going efforts to develop quantitative population models for delta smelt. For instance, Bennett (2005) presented preliminary results from a stage-structured model he is developing to examine tradeoffs among sources of mortality [\*\*68] acting on different cohorts and life stages. *See* AR at 17004-74. The development of this model is part of a broader comprehensive effort by a team of researchers including Dr. Kenneth Rose of Louisiana State University, Dr. Wim Kimmerer of San Francisco State University, Dr. William Bennett of the University of California at Davis, and Dr. Stephen Monismith of Stanford University, who are in the early stages of developing, testing, and applying particle-tracking models, an individual-based model, and a matrix projection model. The development of these particular models is very promising but has also been faced with many challenges. Perhaps the most critical challenge has been a freeze on project funding by the State of California; it is uncertain if the funding will be reinstated. Another example is the work I have been personally involved with at NCEAS. The NCEAS team has used Bayesian changepoint techniques and multivariate autoregressive modeling to identify factors contributing to the decline of delta smelt and other species. The results of this work will be published in two papers in an upcoming issue of the journal *Ecological Applications*. I am aware of at least two other independent [\*\*69] efforts of modeling the effects of various stressors on delta smelt that are also under development. Unfortunately, none of the work I mention above was available when the 2008 BiOp was being prepared. To my knowledge, no comprehensive quantitative population dynamics model for the

delta smelt has been developed, subjected to peer-review, and published.

...[Quantitative population models are grounded in what is known about the biology of a species, and processes that may plausibly affect its abundance.... Although there is a substantial amount of data available on delta smelt, a key problem is that much of the sample data has increasingly contained zero values. These zeros are a reflection of declining population abundance. Such low numbers make it more difficult to acquire more recent information about the factors that drive delta smelt population [\*884] dynamics, such as survival probabilities by life history stage, movement patterns and spatial distribution, and fecundity or reproductive success. It is thus becoming increasingly difficult to not only simply estimate such factors, but also increasingly difficult to model how these factors are affected by environmental and anthropogenic processes [\*\*70] such as those considered in the 2008 BiOp. The estimation of delta smelt population size exemplifies this problem. Newman (2008), *see* AR at 19782-99, recently published a sample design-based procedure for estimating the population abundance of pre-adult and adult delta smelt. However, the resulting estimates of population size were quite imprecise. This was caused, in part, by limitations of the available data to estimating capture probabilities and gear efficiency.

... I agree ... that population dynamics models have been used to evaluate consequences of various stressors on a wide range of species and human impacts. I also agree that there is sufficient data to develop such a model for delta smelt, as demonstrated by the examples I provided above. However, although some are in development, the fact remains that no such model has been fully developed, peer-reviewed and made available for application. Thus, in the absence of such models, I disagree that that the techniques used by USFWS were inconsistent with generally-accepted scientific standards and practices. To the contrary, in the absence of such a model, and because one could not be developed during the time al-

lowed for this [\*\*71] consultation, the techniques used by USFWS do reflect generally-accepted scientific standards and practices.

Decl. of Frederick V. Feyrer<sup>16</sup>, Doc. 541, at ¶¶ 30-33. Plaintiffs do not suggest any party that participated in the preparation of the OCAP Biological Assessment ("OCAP BA" or "BA") or commented on the public review drafts of the BiOp during the consultation submitted to FWS a quantitative life cycle model or the results of such an analysis using a life cycle model for delta smelt.

16 Mr. Feyrer is a Reclamation Fish Biologist with an M.S. in biology. He has extensive experience researching and advising on fisheries management issues in the San Francisco Estuary. Feyrer Decl., Doc. 481, at ¶ 1.

The ESA does not require FWS's to generate new studies. In *Southwest Center for Biological Diversity v. Babbitt*, 215 F.3d 58, 342 U.S. App. D.C. 58 (D.C. Cir. 2000), the district court found "inconclusive" the available evidence regarding FWS's decision not to list the Queen Charlotte goshawk, and held that the agency was obligated to find better data on the species' abundance. The D.C. Circuit reversed, emphasizing that, although "the district court's view has a superficial appeal ... this superficial appeal [\*\*72] cannot circumvent the statute's clear wording: The secretary must make his decision as to whether to list a species as threatened or endangered 'solely on the basis of the best scientific and commercial data available to him....' 16 U.S.C. § 1533(b)(1)(A)." *Id.* at 61 (emphasis added); see also *American Wildlands v. Kempthorne*, 530 F.3d 991, 998, 382 U.S. App. D.C. 78 (D.C. Cir. 2008) (the "best available data" standard "requires not only that the data be attainable, but that researchers in fact have conducted the tests").

Plaintiffs advocate a narrow reading of both *Southwest Center* and *American Wildlands*, arguing these cases only mean that the agency is not required to gather new data in the field regarding a species if such information is not already available. [\*\*885] Doc. 697 at 22. Plaintiffs object that "[n]either of these cases supports Defendants' position that FWS could disregard the smelt abundance data that were already in its possession and fail to undertake the necessary statistical analyses to satisfy its statutory mandate to determine 'whether the action ... is likely to jeopardize the continued existence of the species.' 50 C.F.R. § 402.14(g)(4)." *Id.*

Plaintiffs cite no authority suggesting that the [\*\*73] non-existence of an analytical model should be

treated any differently from the non-existence of raw field data. FWS did not have an off-the-shelf form of "statistical analysis" it could apply to determine the effects of Project Operations on the delta smelt population. Although life-cycle modeling is standard practice in the field of fisheries biology, and a life-cycle model is being (and should have been) developed for delta smelt, it is undisputed that an appropriate life cycle model had not been developed at the time the BiOp issued. FWS must apply the best "available" science; not the best science possible. FWS's failure to apply a life cycle model did not per se violate the ESA or the APA.

It is undisputed that application of a quantitative life cycle model is the preferred scientific methodology. Based on the preponderating expert testimony, FWS had the time and ability to prepare the necessary life-cycle model. FWS made a conscious choice not to use expertise available within the agency to develop one. A court lacks authority to require completion of a life-cycle model. In light of uncontradicted expert testimony that life-cycle modeling is necessary and feasible, FWS's failure [\*\*74] to do so is inexplicable.

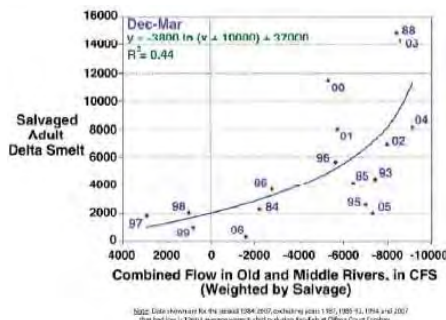
#### c. FWS' Use of Raw Salvage Numbers.

Plaintiffs argue that FWS's use of raw salvage numbers in its quantitative justification for the flow prescriptions in Actions 1 and 2 constitutes a failure to apply the best available science. Action 1, designed to protect up-migrating delta smelt, is triggered during low and high entrainment risk periods based on physical and biological monitoring. Action 1 requires OMR flows to be no more negative than -2,000 cubic feet per second ("cfs") on a 14-day average and no more negative than -2,500 cfs for a 5-day running average. BiOp at 280-81, 329-30. Action 2, designed to protect adult delta smelt that have migrated upstream and are residing in the Delta prior to spawning, is triggered immediately after Action 1 ends or if recommended by the Smelt Working Group ("SWG"). Flows under Action 2 can be set within a range from -5,000 to -1,250 cfs, depending on a complex set of biological and environmental parameters. *Id.* at 281-82, 352-56.

The BiOp provides a quantitative justification for these specific flow prescriptions in Attachment B, entitled "Supplemental Information related to the Reasonable and Prudent Alternative." The following [\*\*75] subsection entitled, "Justification for Flow Prescriptions in Action 1," is critical to the present challenge and is reproduced here in its entirety:

Justification for Flow Prescriptions in Action 1 Understanding the relationship between OMR flows and delta smelt sal-

vage allows a determination of what flows will result in salvage. The OMR-Salvage analysis herein was initiated using the relationship between December to March OMR flow and salvage provided by P. Smith and provided as Figure B-13, below. Visual review of the relationship expressed in Figure B-13 indicates what appears to be a "break" in the dataset at approximately -5,000 OMR; however, the curvilinear fit to the data suggest that the break is not real and [\*886] that the slope of the curve had already begun to increase by the time that OMR flows reached -5,000 cfs.



**Figure B-13. OMR-Salvage relationship for adult delta smelt. (source, P. Smith). Data from this figure were the raw data used in the piecewise polynomial regression analysis.**

Further, a nonlinear regression was performed on the dataset, and the resulting pseudo-R2 value was 0.44--suggesting [\*\*76] that although the curvilinear fit is a reasonable description of the data, other functional relationships also may be appropriate for describing the data. Fitting a different function to the data could also determine the location where salvage increased, i.e. identify the "break point" in the relationship between salvage and OMR flows. Consequently, an analysis was performed to determine if the apparent break at -5,000 cfs OMR was real. A piecewise polynomial regression, sometimes referred to as a multiphase model, was used to establish the change (break) point in the dataset.

A piecewise polynomial regression analysis with a linear-linear fit was performed using data from 1985 to 2006. The linear-linear fit was selected because it was the analysis that required the fewest

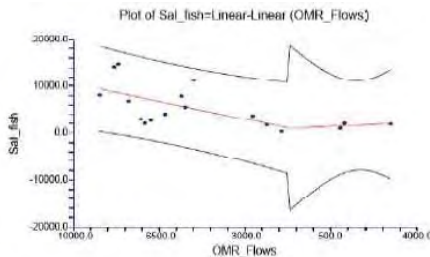
parameters to be estimated relative to the amount of variation in the salvage data. Piecewise polynomial regressions were performed using Number Cruncher Statistical Systems (© Hintz, 1, NCSS and PASS, Number Cruncher Statistical Systems, Kaysville UT).

The piecewise polynomial regression analysis resulted in a change point of -1162, i.e. at -1162 cfs OMR, the slope changed from 0 to positive (Figure B-14). These results [\*\*77] indicate that there is a relatively constant amount of salvage at all flows more positive than -1162 cfs [\*\*87] but that at flows more negative than -1162, salvage increases. The pseudo-R2 value was 0.42, a value similar to that obtained by P. Smith in the original analysis.

To verify that there was no natural break at any other point, the analysis was performed using a linear-linear-linear fit (fitting two change points). The linear-linear-linear fit resulted in two change points, -1,500 cfs OMR and -2,930 cfs OMR. The -1,500 cfs value is again the location in the dataset at which the slope changes from 0 to positive. The pseudo-R2 value is 0.42 indicating that this relationship is not a better description of the data. Because of the additional parameters estimated for the model, it was determined that the linear-linear-linear fit was not the best function to fit the data, and it was rejected. No formal AIC analysis was performed because of the obvious outcome.

A major assumption of this analysis is that as the population of Delta smelt declined, the number offish at risk of entrainment remained constant. If the number offish in the vicinity of the pumps declined, fewer fish would be entrained [\*\*78] and more negative OMR flows would result in lower salvage. This situation would result in an overestimate, i.e. the change point would be more positive. In fact, if the residuals are examined for the relationship in Figure B-13 above, the salvage for the POD years 2002, 2004, 2005, and 2006 are all below the line. 2003 is above the line although the line is not extended to the points at the top of the figure, and these data points occur when

the curve becomes almost vertical. The negative residuals could be a result of a smaller population size available for entrainment and salvage. This could be verified by normalizing the salvage data by the estimated population size based on the FMWT data.



**Figure B-14. Piecewise polynomial regression of OMR flows and salvage. The change point is the location at which the two regression lines meet; -1,162 cfs OMR.**

The original values of OMR and salvage could have been measured with error due to a number of causes, consequently the values used in the original piecewise [\*888] polynomial analysis could be slightly different than the "true" values of salvage and OMR flow. Consequently, a second analysis [\*\*79] was undertaken to examine the effect of adding stochastic variation to the OMR and salvage values in the piecewise polynomial regression analysis. The correlation between OMR and salvage in the original dataset was -0.61 indicating that the more negative the OMR, the greater the salvage. Consequently, it was necessary to maintain the original covariance structure of the data when adding the error terms and performing the regressions. The original covariance structure of the OMR--salvage data was maintained by adding a random error term to both parameters. The random error term was added to OMR and a correlated error term was added to salvage. The expected value of the correlated errors was -0.61.

The error terms were selected from a normal distribution with a mean of 1.0 and a standard deviation of 0.25 which provided reasonable variability in the original data. Operationally this process generated a normal distribution of OMR and salvage values in which the mean of

the distributions were the original data points. Additional analyses were performed with standard deviations of 0.075, 0.025, and 0.125. Smaller standard deviations in the error term resulted in estimates of the change point [\*\*80] nearer to the original estimate of -1,162 cfs. This is to be expected as the narrower the distribution of error terms, the more likely the randomly selected values would be close to the mean of the distribution. The process was repeated one hundred times, each time a new dataset was generated and a new piecewise polynomial regression was performed. The software package @Risk (© Palisade Decision Tools) was used to perform the Monte Carlo simulations. Latin hypercube sampling was used to insure that the distributions of OMR and salvage values were sampled from across their full distributions. The parameter of interest in the simulations was the change point, the value of the OMR flow at which the amount of salvage began to increase. Incorporating uncertainty into the analysis moved the change point to -1,800 cfs OMR, indicating that at flows above -1683, the baseline level of salvage occurred but with flows more negative than -1683, salvage increased.

BiOp 347-51 (emphasis added).

The analyses contained in Figures B-13 and B-14 serve, *inter alia*, as justification for Action 1: setting "break points" above and below which entrainment rates noticeably change. These break points are the foundation [\*\*81] for the tiered flow restrictions in RPA Action 1. Cay Collette Goude <sup>17</sup> stated in her expert declaration that the analysis conducted by Dr. Michael Johnson, set forth in Figure B-13, found inflection points where entrainment started to increase with more negative OMR flows, and that the inflection point "was -1,800 cfs OMR when uncertainty was factored into the analysis." Doc. 470, at ¶ 22. The BiOp does not explain in the "Justification for Flow Prescriptions in Action 1" or elsewhere how or why this -1,800 cfs figure relates to the -2,000 cfs upper limit imposed by Action 1. <sup>18</sup>

<sup>17</sup> Ms. Goude is the Assistant, Field Supervisor for the Endangered Species Program in the Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service. Goude Decl., Doc. 470, at ¶ 1.

18 In explaining actions designed to protect juvenile smelt, Ms. Goude makes reference to another portion of Appendix B, which sets forth the justification for Action 3's restrictions to protect larval smelt. There, the BiOp states that "entrainment risk grows exponentially at OMR flows increasingly more negative than -2,000 cfs." BiOp at 381 (cited in Goude Decl. at ¶ 24). This conclusion appears to be based upon computer [\*\*82] modeling using the Particle Tracking Method ("PTM"). The BiOp does not state that PTM modeling was used to formulate the flow prescriptions imposed by Action 1.

[\*889] Action 2 calls for flows to be set within a range from -5,000 to -1,250 cfs, depending on a complex set of biological and environmental parameters. BiOp at 281-82, 352-56. Although Appendix B describes and justifies Action 2 separately from Action 1, there is no independent section justifying the flow prescriptions imposed by Action 2. Instead, there is a subsection entitled "Justification for Guidelines in Setting Prescriptions of Action 2" which fixes biological and environmental parameters the SWG is to use in setting flows within the -5,000 cfs to -1,250 cfs range. *See* BiOp at 355. There is no independent quantitative or qualitative justification for the upper and lower limits of that range. In fact, the "Justification for Guidelines in Setting Prescriptions of Action 2" section contains the following statement:

Flow requirements defined within Action 2 follow the same protectiveness criterion established during Action 1, as adjusted to reflect real-time conditions and predicted entrainment risk relative to the anticipated [\*\*83] distribution and abundance of year-class delta smelt; and reflecting their behavioral propensity to hold in their chosen spawning habitat. These are allowed to vary based upon assessment of available data as described in the adaptive process described in the Introductions to Actions section above.

BiOp at 356.

Plaintiffs complain that the "Justification for Flow Prescriptions in Action 1" section does not represent the best available science because it is based upon analyses of gross (or "raw") salvage (i.e. the absolute number of fish salvaged over a given time period). The use of raw salvage data, as opposed to salvage data scaled to population size, is problematic because raw salvage figures do not account for the size (or relative size) of the smelt population. Deriso Decl., Doc. 401, at ¶ 28. The BiOp

admits as much, and concedes that the analysis assumes that "as the population of Delta smelt declined, the number of fish at risk of entrainment remained constant." BiOp at 349. Considering raw salvage numbers alone provides no means of distinguishing an event in which 10,000 fish are salvaged out of a population of 20,000 from an event in which 10,000 fish are salvaged from a population [\*\*84] of 20 million. Deriso Decl., Doc. 401, ¶ 28.

There is widespread agreement among the scientific experts that the use of normalized salvage data rather than gross salvage data is the standard accepted scientific methodology among professionals in the fields of fisheries biology/management. Doc. 633-1 at 7, 10 (the 706 experts concluded that, although it is not inherently unreasonable to consider the analysis in Figure B-13, it would be unreasonable to rely on that analysis as the only basis for imposing flow restrictions); Deriso Decl., Doc. 401 at ¶¶ 51-56 (FWS's reliance on Figure B-13 to conclude that as negative OMR flows increase, more adults are salvaged is "scientifically flawed because raw salvage numbers do not have a directly proportional effect on population and do not take into account the overall size of the population...."); Newman Decl., Doc. 484 at ¶ 11 (concurring with Dr. Deriso's "general notion of scaling salvage by some measure of population size.").

[\*890] FWS was aware that raw salvage data posed this obvious problem. The BiOp itself recognized the necessity of normalizing raw salvage data:

To provide context to determine the magnitude of effect of pre-spawning adult direct [\*\*85] mortality through entrainment within any given season (as measured by salvage), it is necessary to consider two important factors ¶ The second factor to consider when relating salvage to population-level significance is that the total number salvaged at the facilities does not necessarily indicate a negative impact on the overall delta smelt population.

BiOp at 338. The August 26, 2008, draft meeting notes of FWS's Delta Smelt Action Evaluation Team state:

When analyzing the importance of entrainment to the species population structure or decline, the relevant fact to consider is the percentage of the population being removed via entrainment. Salvage data, by itself, may not be sufficient to

help one understand the percentage of the population being removed via entrainment.

AR 010023. The Independent Peer Review of FWS's draft Effects Analysis for the BiOp also recommended to FWS that it "normalize[]" salvage to population size:

The panel suggests that the use of predicted salvage of adult smelt should be normalized for population size. Total number salvaged is influenced by a variety of factors, particularly the number of fish in the population.... Expressing salvage as a normalized index [\*\*86] may help remove some of the confounding of the temporal trends during the baseline.

AR 008818. FWS used normalized salvage data in other parts of the BiOp, including the calculation of the Incidental Take Limit, evidencing its ability to do so. *See* Deriso Decl., Doc. 401, at ¶ 55 (citing BiOp at 386).

FWS nowhere explains its decision in the BiOp to use gross salvage numbers in Figures B-13 and B-14, and does not explain why it selectively used normalized salvage data in some parts of the BiOp but not in others. *See* Doc. 633-1 at 10 (Dr. Thomas Quinn, a 706 Expert with expertise in fisheries biology, estuarine ecology, and fish migration and movement, *see* Doc. 394 at 2, stated: "it is not clear why such an adjustment [of salvage to population size] was not made for the data examined in this report."). This was arbitrary, capricious, and represents a failure to utilize the best available science in light of universal recognition that salvage data must be normalized. This significant error must be corrected on remand.

(1) Federal Defendants' Argument that the Flow Prescriptions in Actions 1 and 2 are Otherwise Justified.

Federal Defendants argue that the specific flow prescriptions in Actions [\*\*87] 1 and 2 are supported by more than just Figures B-13 and B-14. By portraying a negative as a positive, Federal Defendants point out that nothing in the BiOp suggests Figures B-13 and B-14 are in fact being used to draw conclusions about what is happening to the delta smelt population as a whole. Doc. 660 at 32. The BiOp concedes that "when relating salvage data to population-level significance [ ] the total number salvaged at the facilities does not necessarily indicate a negative impact upon the overall delta smelt population." BiOp at 338. Instead, Federal Defendants

suggest that the raw salvage numbers are used in "tandem" with other population-based analyses. Other sections of the BiOp demonstrate that salvage by the Project pumping facilities can have a "sporadically significant" effect on the delta smelt population.

[\*891] However, Federal Defendants concede that neither the research supporting the "sporadically significant" finding nor any related discussion in the BiOp generate the kind of "operational metric... needed so that Project pumping can be managed to prevent the entrainment numbers that these other population analyses deem necessary for avoiding population level effects." [\*\*88] Doc. 660 at 32-33. Federal Defendants argue that the raw salvage analyses contained in Figures B-13 and B-14 are used solely to generate these "operational metrics":

That is where raw salvage comes in -- it works in tandem with these other population-based analyses, which Plaintiffs disregard. Specifically, Figures B-13 and B-14 are included to illustrate that the Projects quickly lose the ability to manage entrainment and salvage risk once OMR flows become more negative than -5000 cfs. This is the level at which it is believed that entrainment losses or the take level can be effectively managed. *See* BiOp at 366 (explaining that the function of the OMR flow targets is to manage entrainment risk).

*Id.* at 33. This argument does absolutely nothing to overcome the fact that the use of raw salvage in the analyses depicted in figures B-13 and B-14 is scientifically unacceptable. Those figures cannot accurately depict when the Projects "lose the ability to manage entrainment and salvage risk," because they do not scale salvage to population size. These figures do not take into account the possibility that one data point used to generate the curves depicted may have been collected in a year when [\*\*89] the delta smelt population was 1,000,000, making it more likely that larger numbers of smelt would be present near the pumps to be salvaged, while another data point might have been collected during a year in which the population was 10,000, making it inherently less likely that large numbers of smelt would be found in salvage. The present record suggests that such metrics are meaningless as management tools. They cannot be used to set specific flow prescriptions. FWS was offered the opportunity to, but has not justified its approach.

At the same time, Federal Defendants contend that at least some of the "break points" reflected in the specific flow prescriptions of Components 1 and 2 are based

on information unrelated to Figures B-13 and B-14. For example, in the justification for Action 3, which is designed to protect larval & juvenile smelt, the BiOp relies upon Particle Tracking Model ("PTM") results to explore the likelihood of entrainment of particles in the south Delta (used to represent that portion of the smelt population located in the south Delta) that would likely be entrained at various levels of negative OMR flow. This is referenced as "entrainment risk":

The most efficient [\*\*90] protective measure for protecting the resilience and not precluding the recovery of the delta smelt population specific to the larval/juvenile lifestage is to prevent entrainment of fish in as large a portion of the Central Delta as is practical. Results of PTM modeling focusing on protections at station 815 (Prisoner's Point) indicates that precluding entrainment of larval/juvenile delta smelt at this station would also protect fish at station 812 (Fisherman's Cut) and other stations north and west (downstream) of station 815. While the target entrainment at station 815 would ideally also be zero, there appears to be little additional entrainment protection (less than 5 percent) at OMR flows at -750 cfs (the strictest level addressed by Interim Remedies). However, entrainment risk grows exponentially at OMR flows increasingly more negative than -2000 cfs.

[\*892] Figure B-16 displays injection points for modeled particle tracking runs that were conducted in February 2008 with injection points at Stations 711, 809, 812, 815, 902, 915. This figure plots projected relationships for OMR flows by injection point, including entrainment probabilities for station 815 (over 30 days).

The results from [\*\*91] these runs indicate an approximate <5 percent entrainment risk at OMR flow not more negative than -2000 cfs. At a requirement of -3,500 cfs OMR flow, entrainment risk at station 815 is roughly 20 percent over each 30 day interval. Assuming cumulative entrainment is additive, over a roughly four month (~120 days) interval in which Action 3 would be under effect, consistently operating at -3,500 OMR would yield a net entrainment probability

placing at risk approximately 80 percent of the larval/juvenile subpopulation utilizing the South Delta at and below Station 815. If immigration of larval smelt from the Central or North Delta into the zone of entrainment during spring were to occur, the population-level risk would be even greater. Such entrainment levels are potentially a significant adverse risk to delta smelt population.

BiOp at 366-68.

Although it seems logical that the PTM results and the "entrainment risk" PTM attempts to estimate have some applicability to the protection of adult smelt, the BiOp does not rely upon these results to justify Actions 1 or 2. *NWF v. NMFS II*, 524 F.3d at 932, n.10 (a court "may not consider [a] post hoc justification, or infer 'an analysis that is [\*\*92] not shown in the record.'")(quoting *Gifford Pinchot Task Force*, 378 F.3d at 1074, and citing *PCFFA v. U.S. Bureau of Reclamation*, 426 F.3d 1082, 1091 (9th Cir. 2005) ("[W]e cannot infer an agency's reasoning from mere silence," and "an agency's action must be upheld, if at all, on the basis articulated by the agency.")).

Federal Defendants also point out that Action 1 is based on "the historical observation that the first 'winter flush' moves delta smelt into portions of the delta where they are particularly vulnerable to entrainment, for biological and hydrological reasons that are well documented." Doc. 660 at 23 (citing BiOp at 333-36). Federal Defendants argue:

As the multiple sources of information relied upon by the BiOp on this point demonstrate, pumping reductions during these critical vulnerability periods will demonstrably reduce entrainment and entrainment risk. *See id.* According to the BiOp, the piece-wise regression set forth in Figure B-14 of the BiOp was used to provide some indication of what level of exports would reduce entrainment during these first flush events, and not, as Plaintiffs assert, to analyze the impacts of salvage relative to the population. *See* BiOp at 350.

Doc. [\*\*93] 660 at 23. The BiOp arguably supports the assertion that a "winter flush" can move smelt into areas of the delta where they are particularly vulnerable.

See BiOp at 331. However, nothing in the discussion of the timing, characteristics, or indicators of the winter flush explains why -5,000 cfs was set as the ceiling on negative OMR flows, rather than some other figure. That justification appears to come exclusively from Figures B-13 and B-14, which rely upon the flawed analyses of raw salvage.

Finally, Federal Defendants attempt to justify the use of raw salvage numbers in calculating the -5,000 cfs ceiling by a convoluted argument that Kimmerer's work proves raw salvage trends generally follow population trends. Kimmerer's work did [\*893] evaluate the population-level effects of project operations. The BiOp explains:

This effects analysis evaluates the proposed action operations by exploring long-term trends in Delta outflow, or X2, and OMR flows during March-June and comparing these to hydrodynamic conditions expected based on CALSIM II modeling presented in the biological assessment. The analysis uses the larval-juvenile entrainment estimates provided by Kimmerer (2008) and flow and export [\*94] projections from the biological assessment to estimate the annual percentages of the larval/juvenile delta smelt population expected to be entrained . . . .

Kimmerer (2008) proposed a method for estimating the percentage of the larval-juvenile delta smelt population entrained at Banks and Jones each year. These estimates were based on a combination of larval distribution data from the 20-mm survey, estimates of net efficiency in this survey, estimates of larval mortality rates, estimates of spawn timing, particle tracking simulations from DWR's DSM-2 particle tracking model, and estimates of Banks and Jones salvage efficiency for larvae of various sizes. Kimmerer estimated larval-juvenile entrainment for 1995-2005. We used Kimmerer's entrainment estimates to develop multiple regression models to predict the proportion of the larval/juvenile delta smelt population entrained based on a combination of X2 and OMR.

BiOp at 219-220 (emphasis added). The BiOp used a similar approach for adult delta smelt:

Kimmerer (2008) calculated that entrainment losses of adult delta smelt in the winter removed 1 to 50 percent of the estimated population and were proportional to OMR flow, though the high [\*95] entrainment case might overstate actual entrainment. Given there are demonstrated relationships between smelt entrainment and salvage with OMR flows (Kimmerer 2008; Grimaldo et al. accepted manuscript), this effects analysis evaluates the proposed action operations by comparing the long-term trends in OMR flows to OMR flows in the CALSIM II modeling presented in the biological assessment. For both approaches, predictions of salvage and total entrainment losses were made using OMR flow since it was the best explanatory variable of each. The effects of proposed operations were determined by comparing actual salvage and entrainment losses with predictions of these parameters under modeled OMR flows.

BiOp at 211 (emphasis added). Kimmerer did calculate proportional population-level losses for both adults and juveniles. See *id.*; see also BiOp at 212, 250-252, 262 (presenting model simulation results in Figures E4-E6 and E16 which estimate proportional population losses based on entrainment). It is undisputed, however, that Kimmerer did not generate any operational metrics or attempt to calculate the point above or below which OMR flows would have particular effects on the smelt population. [\*96] As a result, there was no basis to rely on Kimmerer's work alone to justify the specific OMR flows imposed by Actions 1 and 2. Federal Defendants point to a section of the BiOp's Effect's Analysis that concludes that because "over a given span of years, the project as proposed will increase larval/juvenile entrainment relative to 1995-2005 levels," "[t]his will have an adverse effect on delta smelt based on their current low population levels." BiOp at 222. However, this conclusion references Figure E-18, which attempts to estimate the likelihood of having an event that would entrain a significant proportion of the smelt population, thereby evaluating the effect of particular circumstances [\*894] on the smelt population. See BiOp at 264. This language provides no support for Federal Defendants' assertion that the BiOp connects population level effects to raw salvage figures.

Federal Defendants assert "Kimmerer (2008), like the BiOp, concluded that once raw entrainment numbers

approach a certain level, population-level effects will occur." Doc. 660 at 25 (citing BiOp at 159, 164-65, 210; AR at 18854-18880). Federal Defendants describe this as the "Kimmerer Approach," and argue:

The Kimmerer [\*\*97] (2008) study shows that salvage trends generally follow population loss trends. *See* BiOp at 206-207; *see also* AR at 18854-18880. Salvage data is then used to ascertain the pumping level at which entrainment risk can no longer be managed to a level that prevents harm to the population as a whole. *See* BiOp at 338. Using the Kimmerer approach, by managing salvage, the BiOp manages population-level losses.

Doc. 660 at 25. This description is not supported by the record. The BiOp does not rely upon Kimmerer (2008) or any other source to conclude that salvage trends generally follow population loss trends. This is FWS's invention to support its arbitrary flow limit.

FWS nowhere explains in the BiOp or the AR how the sporadically significant population-level effects identified in Kimmerer (2008) factored into the quantitative analysis that led to the -5,000 cfs OMR flow limit imposed in RPA Action 2. Nowhere does the BiOp or the record explain how the analysis in Fig. B-13 "works in tandem" with the purported numeric results of Kimmerer (2008), and nowhere does the BiOp or the record state that Fig. B-13 was intended to create an "operational metric" to manage pumping to avoid "certain raw [\*\*98] entrainment numbers." This is an abdication of the duty to satisfy the basic APA requirement that the agency "articulate[] a rational connection between the facts found and the choice made." *Ariz. Cattle Growers' Ass'n*, 273 F.3d at 1236.

Federal Defendants argue that, even if FWS had used a scaled salvage index to calculate the OMR flow ceiling, the results would not have been appreciably different. For the purposes of demonstrating the difference between the analysis presented in the BiOp and a population-normalized analysis, Dr. Deriso analyzed the relationship between normalized salvage and OMR flows. He initially concluded that there is "no statistically significant relationship between OMR flows and adult salvage for flows less negative than -6,100 [cfs] at the very least." Deriso Decl., Doc. 401 at ¶¶ 62-65. <sup>19</sup> Federal Defendants' expert criticized Dr. Deriso's alternative analysis in a number of ways, including that Dr. Deriso failed to correct for potentially large sampling errors. Newman Decl., Doc. 484, at ¶ 12. Dr. Newman ran his own analysis, applying a different standard statistical methodology

to the same data used by Dr. Deriso, and got different results regarding the [\*\*99] "inflection point" where OMR flows had an increasing impact on the population-normalized salvage rate. *Id.* & Ex. C (identifying inflection point at -4,000 cfs, which is within the OMR flow target [\*\*95] ranges established in the BiOp). Ultimately, however, Dr. Newman agreed that an analysis utilizing raw salvage numbers (i.e., not adjusted for relative population size) is scientifically inappropriate. *Id.* at ¶ 11. That other researchers were able to produce generally consistent inflection points through the use of more appropriate statistical methodologies does not excuse FWS's failure to do so. The difference between a -6,100 cfs ceiling and a -4,000 cfs ceiling is very substantial in the amount of lost annual water supply, with resulting adverse effects on human welfare and the human environment. FWS was required to perform an accurate scientific analysis and justify its ultimate decision regarding the imposition of a water flow ceiling. <sup>20</sup>

19 Dr Deriso testified: "specifying that the ceiling on [OMR] flows should have been set at no lower than negative 6100 cfs" was stricken as post hoc extra record evidence. However, no party moved to strike Dr. Newman's similar, post hoc analysis. Dr. [\*\*100] Deriso's analysis is considered here only as a counterpoint to Dr. Newman's, not to prove the validity of -6,100 as the appropriate ceiling.

20 Federal Defendants point out that the BiOp also relied on the 2006 Manly and Chotkowski study, which found a statistically significant relationship between exports and smelt abundance as measured by Fall Midwater Trawl ("FMWT") catches, *see* AR 019672 (cited in BiOp at 156), as well as the Interagency Ecological Program's 2007 Synthesis Report on the Pelagic Organism Decline Team, which stated that "... entrainment of adults and larvae (top-down effects) are particularly important to the delta smelt population...." AR 016922 (emphasis added); *see also* Goude Decl., Doc. 470, at ¶¶ 6-7. However, none of these studies correlate raw salvage to population-level losses, nor do they otherwise justify the imposition of the particular flow regime the BiOp imposes.

## (2) Use of Raw Salvage Analyses in Justification for Action 3.

Action 3, which is designed to "[m]inimize the number of larval delta smelt entrained at the facilities by managing the hydrodynamics in the Central Delta...", limits net daily OMR flow to no more negative than -1,250 to -5,000 cfs, [\*\*101] based on a 14-day running average with a simultaneous 5-day running average

within 25 percent of the applicable requirement for OMR. BiOp at 357. Action 3 establishes guidelines the SWG is to use when recommending where to set the OMR flow level within this range. *Id.* The BiOp anticipates that during most conditions, OMR flows will range between -2,000 and -3,500 cfs. *Id.* at n. 10. During certain years of higher or lower predicted "entrainment risk," flows as low as -1,250 or as high as -5,000 may be recommended. *Id.*

Plaintiffs do not challenge the basis for the low end of the range (-1,250 cfs) or the criteria used to formulate recommendations within the middle of the range. Plaintiffs do argue that the upper end of the range (-5,000 cfs) is based solely on FWS's raw salvage analysis and should be invalidated.

The BiOp explains in the section of Attachment B addressing Action 3 that "[t]wo scenarios span the range of circumstances likely to exist during Action 3":

First, *the low-entrainment risk scenario.* There may be a low risk of larval/juvenile entrainment because there has been no evidence of delta smelt in the South and Central Delta or larval delta smelt are not yet susceptible [\*\*102] to entrainment. *In this scenario, negative OMR flow rates as high as -5,000 cfs may occur as long as entrainment risk factors permit.*

The second scenario, the high-entrainment risk *scenario*, is one in which either (a) there is evidence of delta smelt in the South and Central Delta from the SKT and/or 20mm survey, or (b) there is evidence of ongoing entrainment, regardless of other risk factors. In this case, OMR should be set to reduce entrainment and/or the risk of entrainment as the totality of circumstances warrant.

Usually, if the available distributional information suggests that most delta smelt are in the North or North/Central Delta, then OMR flow can be chosen to [\*\*896] minimize Central Delta entrainment. However, if the distributional information suggests there are delta smelt in the Central or South Delta, then OMR flows will have to be set lower to reduce entrainment of these fish. If delta smelt abundance is low, distribution cannot be reliably inferred. Therefore, the adaptive process is extremely important. The SWG may recommend any specific OMR flow within the specified range above.

BiOp at 358 (underlined emphasis in original; emphasis in italics added). The Action 3 discussion [\*\*103] does not provide an independent justification for the choice of -5,000 cfs as the upper limit for OMR flows under the low entrainment risk scenario. Federal Defendants suggest that the upper limit is justified in the Delta Smelt OCAP Team's notes, which indicate that "[a]t -5,000 OMR, the model shows 40% entrainment at station 815." AR 009459. This is a reference to the PTM model results. There are two major problems with Federal Defendants' reliance on this statement. First, it is contained within a section of the Delta Smelt OCAP Team notes entitled "Actions 1 and 2." AR 009457-60. Even if this statement was made in reference to Action 3, it does not justify using -5,000 cfs as the upper limit. The PTM study assumed an upper limit of -5,000 cfs and never considered any flow ranges above that. Nor is it made clear why 40% particle entrainment is a rational threshold of significance, as opposed to some lower or higher threshold. In sum, the PTM study does not justify the imposition of -5,000 cfs as an upper limit in Actions 1, 2, or 3.

The "Action #3" section of the Team's notes does contain an explanatory statement regarding the source of the -5,000 cfs upper boundary for Action 3: [\*\*104] "The -5,000 OMR cap was established by Wanger." AR 009463; *see also* AR 009462 ("[t]he group discussed the merits of using the -5,000 OMR per Wanger Order"). It is unclear how FWS can rely directly on a provisional court order, entered as a remedial stopgap measure pending comprehensive scientific analysis, to establish the scientific basis for an RPA. The subject Order was the result of an Interim Remedies proceeding in the challenge to the previous Delta Smelt BiOp. After an evidentiary hearing, it was determined from the then available data that "the number of Delta smelt entrained at the CVP and SWP export facilities begins to rise significantly when negative flows on the OMR exceed approximately -5,000 cfs. [Tr. 641:14-642:5; 725:16-17; DWR Ex. D ¶ 4; DWR Ex. G ¶ 34; SWC Ex. N]." *NRDC v. Kempthorne*, 1:05-cv-1207, Doc. 561, Int. Rem. Findings, at ¶ 38. The finding was based on two studies of the relationship between OMR flows and smelt salvage: (1) a non-linear model presented by Sheila Greene of DWR; and (2) the linear model created by Peter Smith, which became the basis for Figure B-13. Both of these analyses utilized raw salvage data. AR 009251 (Green's analysis); *see also* 1:05-cv-1207, [\*\*105] Doc. 399, Decl. of Jerry Johns, Ex. B and C; 1:05-cv-1207, Doc. 419, Decl. of Christina Swanson, at 12, Fig. 8. That raw salvage studies were previously relied upon by the Court, when no

others were available, does not validate their use in the 2008 Smelt BiOp.

d. FWS's Comparison of CALSIM II Data to DAY-FLOW Data.

The BiOp's effects analysis used analytical methods and data, "including the CALSIM II model outputs provided in the appendices of Reclamation's 2008 OCAP BA, historical hydrologic data provided in the DAY-FLOW database, statistical summaries derived from 936 unique 90-day particle tracking simulations published by [\*897] Kimmerer and Nobriga (2008), and statistical summaries and derivative analyses of hydrodynamic and fisheries data published by Feyrer et al. (2007), Kimmerer (2008), and Grimaldo et al. (accepted manuscript)." BiOp at 204.

CalSim II is a computer model developed jointly by DWR and Reclamation. Declaration of Aaron Miller,<sup>21</sup> Doc. 548-1, at ¶ 5. The model simulates SWP and CVP operations and is the standard planning tool for evaluating project operations. *Id.* at ¶ 6. CalSim II has been continuously updated since it was first applied in 2002. *Id.* at ¶ 8. CalSim II simulates [\*\*106] SWP and CVP reservoir operations, project exports and water deliveries, flow through the Delta, and salinity requirements in the Delta, including the location of X2. *Id.* at ¶ 7.

21 Mr. Miller is DWR's Technical Senior Water Resource Engineer and possesses expertise in CALSIM II and Dayflow modeling. Miller Decl., Doc. 548-1, at ¶¶ 1-3.

CalSim II uses historic hydrologic data from October 1922 to September 2003, including precipitation, runoff into reservoirs and inflow into the Delta from unimpaired streams. Miller Decl., Doc. 548-1, at ¶ 10 & n.1. The model further assumes a level of development, which reflects water demand resulting from particular levels of urban population, agricultural production, and wildlife refuge needs, *id.* at ¶ 10, along with the effect of environmental regulations and programs, *id.* at ¶ 27; BiOp at 207. CalSim II is capable of estimating the position of X2. Miller Decl., Doc. 548-1, at ¶ 14.

The BiOp considered a number of CalSim II studies, either directly or indirectly:

o Study 6.0 was designed to represent the assumptions used in the 2004 OCAP BA within the updated CalSim II model framework in order to highlight changes from the previous model framework. This [\*\*107] Study models a 2005 level of development and includes steps to account for operations under CVPIA (b)(2) and

Joint Point of Diversion<sup>22</sup>. See OCAP BA at 9-32 (AR 010729).

o Study 6.1 is similar to 6.0, except that the 2005 Trinity River Record of Decision is removed, and the Joint Point of Diversion is not accounted for. *Id.*

o Study 7.0 was developed as the baseline study for the OCAP BA. Study 7.0 represents existing conditions, and assumes a 2005 level of development and a full environmental water account ("EWA")<sup>23</sup>. BiOp at 207.

o Study 7.1 is a near-future conditions study. It assumes a 2005 level of development and a limited EWA. BiOp at 207-08.

o Study 8.0 is a future conditions study. It assumes a 2030 level of development and a limited EWA. BiOp at 208.

[\*898] o The 9.0 series of studies represents climate change scenarios. BiOp at 208.

22 State Water Resources Control Board Decision 1641 granted Reclamation and DWR the ability to "use/exchange each Project's diversion capacity capabilities to enhance the beneficial uses of both parties...." with certain conditions. BiOp at 26.

23 The EWA was originally designed to compensate CVP and SWP contractors for loss of water to facilitate reduced diversions [\*\*108] from the Delta at times when at risk fish species may be harmed. BiOp at 34. "Typically the EWA replaced water loss due to curtailment of pumping by purchase of surface or groundwater supplies from willing sellers and by taking advantage of regulatory flexibility and certain operational assets." *Id.* However, at the time the BiOp was issued, the agencies that manage the EWA were undertaking environmental review to determine the future of the EWA. *Id.* As a result, the BiOp treats EWA as a "limited" asset in some circumstances. *Id.*

The OCAP BA suggested using Calsim II Study 7.0 as the current baseline and Study 6.1 as the historical baseline for evaluating the impacts of project operations. BiOp at 204. However, the BiOp rejected this suggestion because, although "changes were expected between

Study 6.1 and Studies 7.0 and 7.1," the modeled results were "nearly identical." *Id.* FWS concluded from this result that CalSim II could not accurately generate an empirical baseline. *See id.* at 204-06. Instead, FWS chose to "use actual data to develop an empirical baseline," including the use of the Dayflow model to "develop[] historical time series data for hydrologic variables." BiOp at 206. [\*\*109] Dayflow is a model that estimates historic outflow based on historic precipitation, inflow, and exports, and estimates of delta island diversions.

Dayflow also provides an estimate for the location of X2. Miller Decl., Doc. 548-1, at ¶¶ 14-15.

In the BiOp, FWS purports to quantify adult entrainment by comparing OMR flows from CalSim II studies to historic OMR flows during 1967-2007. BiOp at 212-13. The BiOp depicts these results in Tables E-5a, E-5b, and E-5c:

**Table E-5a. Historic and CALSIM II modeled median winter (Dec-Mar) OMR flows by water year type**

Water year type	Historic	7	7.1	8	9	9.1	9.2	9.3	9.4	9.5
Wet	-1033	-5256	-5498	-5699	-5684	-5500	-3999	-3678	-7066	-6100
Above Normal	-5178	-7209	-7923	-8073	-8156	-7595	-6863	-6934	-7861	-7723
Below Normal	-2405	-6461	-7208	-7009	-6599	-6420	-5647	-6736	-6721	-6343
Dry	-5509	-6443	-6931	-6692	-6620	-6353	-6831	-7438	-5785	-5760
Critical	-5037	-4547	-4931	-4980	-5051	-4588	-5320	-5194	-4260	-3845

**Table E-5b. Winter OMR Flow percent difference from historic median value to CALSIM II model median value**

Water year type	7	7.1	8	9	9.1
Wet	408.92%	432.37%	451.84%	450.36%	432.50%
Above Normal	39.21%	53.01%	55.90%	57.49%	46.67%
Below Normal	168.62%	199.68%	191.41%	174.35%	166.90%
Dry	16.95%	25.81%	21.48%	20.17%	15.32%
Critical	-9.74%	-2.12%	-1.14%	0.27%	-8.92%

**Table E-5b. Winter OMR Flow percent difference from historic median value to CALSIM II model median value**

Water year type	9.2	9.3	9.4	9.5
Wet	287.16%	256.13%	584.15%	490.63%
Above Normal	32.53%	33.91%	51.80%	49.13%
Below Normal	134.75%	180.05%	179.42%	163.72%
Dry	24.01%	35.02%	5.01%	4.57%
Critical	5.61%	3.11%	-15.44%	-23.68%

**Table E-5c. Percent difference from historic median salvage to predicted salvage based on Dec-Mar OMR flows from CALSIM II studies**

Water year type	Study 7	Study 7.1	Study 8	Study 9	Study 9.1
Wet	45.64%	48.26%	50.43%	50.26%	48.27%
Above Normal	15.15%	20.49%	21.60%	22.22%	18.04%
Below Normal	38.17%	45.20%	43.33%	39.46%	37.78%
Dry	6.80%	10.36%	8.62%	8.09%	6.15%
Critical	-3.70%	-0.81%	-0.43%	0.10%	-3.39%

**Table E-5c. Percent difference from historic median salvage to predicted salvage based on Dec-Mar OMR flows from CALSIM II studies**

Water year type	Study 9.2	Study 9.3	Study 9.4	Study 9.5
Wet	32.05%	28.59%	65.20%	54.76%
Above Normal	12.57%	13.10%	20.02%	18.99%
Below Normal	30.50%	40.76%	40.61%	37.06%
Dry	9.63%	14.05%	2.01%	1.83%
Critical	2.13%	1.18%	-5.87%	-9.00%

[\*899] Tables [\*\*110] E-5b and E-5c depict changes in OMR flows and entrainment using the Day-flow-generated historic data as the baseline and comparing that to CalSim II study results. In addition, the BiOp utilized an equation taken from Kimmerer's [\*900] 2008 paper to estimate the population loss of delta smelt under the various modeled scenarios. The results of these calculations were depicted in Figures E-5 and E-6:

Figure E-5. Frequency distribution of predicted adult delta smelt entrained at Banks and Jones for predicted estimates from historic data (1967-1994), actual estimates from Kimmeier (2008) for years 1995-2006, and those estimated from CALSIM II model data by study.

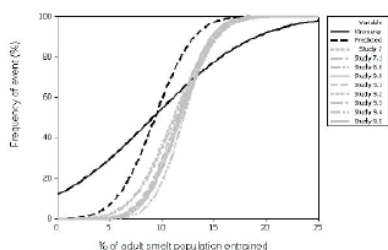
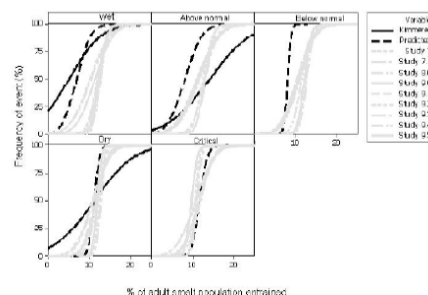


Figure E-6. Same as E-5 but by water year type. Kimmerer (2008) estimates did not include below normal or critical dry water year types.



[\*901] BiOp at 251-52. The accompanying text explains the significance of these results to the analysis:

The median OMR flows from the CALSIM II modeled scenarios were more negative than historic OMR flow for all WY types except critically dry years (Figure E-3; see Table E-5b for all differences). Overall, proposed OMR flows are likely to generate increases in population [\*\*111] losses compared to historic years (Figure E-5 and Figure E-6). For example, the frequency of years when population losses are less than 10 percent from most modeled studies (except studies 7.0 and 8.0) is less than 24 percent compared to

historic estimates that only exceed 10 percent in approximately half of the years.

The most pronounced differences occur during wet years, where median OMR flows are projected to be approximately 400 to 600 percent (-7100 to -3678 cfs) higher than historical wet years (-1032 cfs). Generally, wet years are marked by low salvage and population losses. However, the proposed operations during wet year are predicted to cause up to a 65 percent increase in smelt salvage and lower probability that population losses will be below 10 percent.

The proposed operation conditions likely to have the greatest impact on delta smelt are those modeled during above normal WYs. The modeled OMR flows for the above normal WYs ranged between -8155 and -6242 cfs, a 33 to 57 percent decrease from the historic median of -5178 cfs. Though the predicted salvage would only be about 15-20 percent higher than historic salvage during these years (Table E-5c), the modeled OMR flows [\*\*112] in these years would increase population losses compared to historic years.

In below normal and dry WYs, proposed OMR flows are also modeled to decrease from historic medians. Predicted salvage levels are likely to increase between 2 and 44 percent. More importantly, the modeled median flows from all studies in these WY types range between -5747 and -7438 cfs. Modeled OMR flows at these levels are predicted to increase salvage and increase the population losses from historic levels as well.

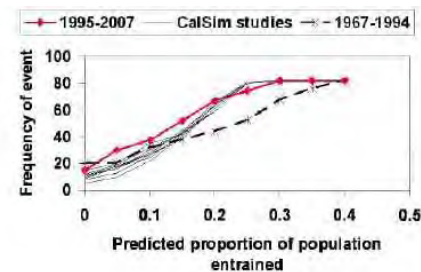
During critically dry years, the median OMR flows for studies 7.0, 7.1, 8.0, 9.1, 9.4, and 9.5 are less than -5,000 cfs. These studies have predicted salvage lower than historic salvage and are not likely to generate larger population losses compared to historic years. The models might overestimate salvage during critical dry years when smelt are unlikely to migrate towards the Central Delta due to lack of turbidity or first flush. Thus, the effects of critical dry operations on delta smelt take are probably small and lower than estimated.

BiOp at 212-13.

Based on these comparisons of CalSim II data and Dayflow-generated historic data, the BiOp concludes, "adult entrainment is likely to be higher than [\*\*113] it has been in the past under most operating scenarios, resulting in lower potential production of early life history stages in the spring in some years." BiOp at 213.

The BiOp performed comparisons of CalSim II data to Dayflow-simulated historic baseline data to quantify the effects of the action on larval and juvenile delta smelt. *See, e.g.*, BiOp at 219 (examining effect of action on larval and juvenile entrainment: "[t]he analysis is based on comparison of historical (1967-2007) OMR and X2 to the proposed action's predictions of these variables provided in ... [CalSim] studies 7.0, 7.1, 8.0, and 9.0-9.5"). Figure [\*902] E-18 depicts several sets of calculations of the frequency at which certain percentages of the delta smelt population would be entrained:

Figure E-17. Frequency distribution of estimated proportions of larval-juvenile delta smelt entrained at Banks and Jones for 1967-1994 and 1995-2007. The data were extrapolated to an 82-year period to make them comparable to the CALSIM II out



BiOp at 264. The black dashed line depicts entrainment estimates for Dayflow-generated historic data from 1967 to 1994, the red line with diamonds depicts entrainment estimates [\*\*114] for Dayflow-generated historic data from 1995-2007, and the fine lines depict the various entrainment estimates based on Calsim II data. Based on these calculations, the BiOp concludes that "the proposed action will decrease the frequency of years in which estimated entrainment is 15 percent. Thus, over a given span of years, the project as proposed will increase larval juvenile entrainment relative to 1995-2005 levels. This will have an adverse effect on delta smelt

based on their current low population levels." BiOp at 222.

A separate BiOp analysis purports to quantify the effects of the project operations on delta smelt habitat by comparing CalSim II model projections of the location of X2 under the proposed operations to the median location of X2 over the historical period 1967-2007, as simulated by Dayflow. BiOp at 235-36. Based on this comparison, the BiOp concludes "[t]he median X2 [locations] across the CalSim II modeled scenarios were 10-15 percent further upstream than actual historic X2 (Figure E-19)." *Id.* at 235. In reliance on these percent differences between CalSim II-created data and historical data, the BiOp concludes: "proposed action operations are likely to negatively [\*\*115] affect the abundance of delta smelt." *Id.* at 236.

According to Plaintiffs, the comparison of Calsim II to Dayflow outputs distorts the BiOp in several key ways:

(1) The comparison of outputs of these two models in the Project Effects analysis is, *ipso facto*, a violation of the best available science requirement.

[\*903] (2) To use Dayflow, which represents historical conditions, to generate the baseline for the Project Effects analysis, improperly attributes past effects to the Projects;

(3) Because the flawed comparison was used to support imposition of Component 3 (Action 4) (a/k/a the "fall X2" action), that Action is invalid.<sup>24</sup>

<sup>24</sup> In some of the briefs, this third argument is presented with Plaintiffs' other challenges to the Fall X2 action. It is most logical and efficient to address this issue with Plaintiffs' challenges to the use of the Calsim II versus Dayflow comparisons in the Project Effects Analysis.

Plaintiffs also argue that the BiOp improperly attributes all (or substantially all) of the observed, historical upstream shift of X2 to Project Operations. It is preferable to address these contentions with related arguments in Part VII.A.(6).

(1) Was FWS's Decision to Compare Calsim II [\*\*116] to Dayflow Model Runs a Violation of the Best Available Science Requirement?

Mr. Aaron Miller opines that outputs from a CalSim II study should not be compared to outputs from the Dayflow model because the assumptions used in the two models are significantly different. Miller Decl., Doc. 548-1, at ¶¶ 22-55. He identified the following key differences between the models:

o Level of Development: The CalSim II model assumes a constant level of development. In contrast, the Dayflow model incorporates a continuous change in the level of development because the Dayflow model is using historical information as input. When comparing models to determine the effect of project operations, the best scientific practice is to keep the assumed level of development constant. *Id.* at ¶¶ 31-38.

o Regulatory Assumptions: CalSim II assumes a constant regulatory environment, whereas Dayflow uses a regulatory environment that has changed over time. Over the past 40 years, numerous regulatory programs have altered the way the projects are operated, including D-1485, D-1641, the Central Valley Project Improvement Act ("CVPIA"), the 1995 Water Quality Control Plan, and the EWA. These differences "further undermine [\*\*117] the reliability of comparing historically based Dayflow values to the Calsim II model results." *Id.* at ¶¶ 39-41.

o Time Step: CalSim II operates on a monthly time step, whereas Dayflow operates on a daily time step. *Id.* at ¶ 42.

o Operational/Computational Guidelines: The Dayflow model incorporates real-world conservative operational tactics designed to avoid violating applicable regulations. In contrast, the CalSim II model operates strictly to that regulation. *Id.* at ¶ 44. Operating conservatively results in higher modeled outflow. *Id.*

o Year Range: The Dayflow model uses a different historic time window than CALSIM II. The BiOp used values from 1967 to 2007 as inputs into the Dayflow model, while 1922 to 2003 were used for Calsim II. *Id.* at ¶ 52. This introduces additional error into any comparison between outputs of these two models because the time period used for the Dayflow model had a higher percentage of

wet or above normal years, as compared to the time period covered by Calsim II. *Id.* at ¶ 53.

o Method for Calculating position of X2: The artificial neural network [\*904] ("ANN") and the Kimmerer Monismith equation ("KM equation") are two methods of estimating X2. *Id.* at ¶ 46. The CalSim [\*118] II studies used ANN to estimate the position of X2, while the Dayflow model uses the KM equation. *Id.* at ¶ 47. Holding all other variables constant, but varying the method (ANN v. KM) used, produces inconsistent results. At locations less than 75 kilometers ("km") from the Golden Gate, the KM equation results in an X2 estimate greater than (or farther upstream than) the ANN estimate. In contrast, at locations greater than 75 km from the Golden Gate, the KM equation provides an estimate less than the ANN estimate. *Id.* at 11, Fig. 2.

Mr. Miller opined that best scientific practice is to compare models that use consistent assumptions and methodologies. *See id.* at ¶¶ 38, 51, 54; *see also id.* at ¶ 41. The approach taken in the BiOp, quantitatively comparing Calsim II runs to Dayflow model outputs "introduces significant error into the analysis." *Id.* at ¶ 56.

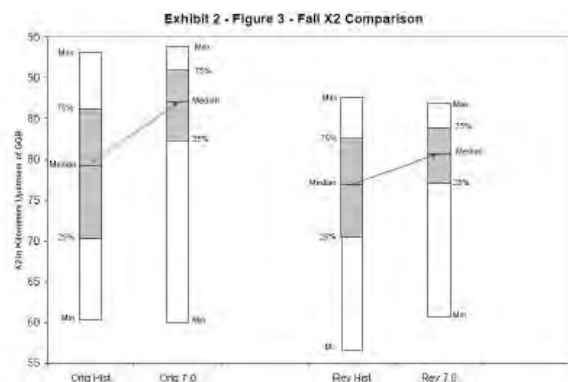
Dr. Punt, a 706 Expert added that "[i]n principle, there is nothing wrong with fitting a model using a set of OMR/X2 valued from one model and making predictions using OMR/X2 values which are based on the output from a different model, as long as the two sets of values are calibrated.... Not calibrating the two sets of model outputs will [\*119] lead to some bias in the inferences, with the level of bias dependent on the net effect of all the differences between the 'historical' and Calsim II values for the same years." Doc. 633-1 at 15.

Mr. Derek Hilts, a FWS employee who previously served as "Engineer-in-Charge" of CVP/SWP modeling for Reclamation, disagrees with Mr. Miller's general opinion that comparing Calsim II and Dayflow outputs is *per se* scientifically unreliable, noting that the OCAP BA's Appendix D specifically compared Calsim II and Dayflow runs for the purposes of testing "Calsim II's ability to simulate the CVP/SWP system reasonably well." Decl. of Derek Hilts, Doc. 540, at ¶ 11. But, as Mr. Miller explains, this type of "validation comparison" is designed to "help establish the credibility of the Cal-Sim II model by showing that the model moves water, simulates operation of the export pumps, and so forth,

with the same general timing and magnitude as actual historical data show." Second Miller Decl., Doc. 597, at ¶ 12. In fact, Mr. Miller points out that the detailed validation data contained in the OCAP BA demonstrate that, although Calsim II outputs generally track historical data, they "do not precisely match [\*120] the actual historical data." *Id.* at ¶ 12. Because validation is "looking only at the general operational performance of the model," a validation comparison "does not need to control for the effects of all the differences in the model and the historical measurements...." *Id.* at ¶ 13.

More specifically, Mr. Hilts disagrees with Mr. Miller's critique that the divergent methods of calculating the position of X2 render the comparison used in the BiOp scientifically inappropriate. Mr. Hilts does not dispute Mr. Miller's conclusion that the KM and ANN equations produce marginally different outcomes. Instead, Mr. Hilts criticizes Mr. Miller for failing to "assert that any such error would have changed the conclusions drawn in the BiOp." Doc. 540 at ¶ 19.

Assumedly to demonstrate that the conclusion would not have changed, Mr. Hilts revisited the calculations in the BiOp, using the KM equation in both models to [\*905] produce revised estimates of the position of X2. <sup>25</sup> In performing this analysis, Mr. Hilts also attempted to correct for one of the other purported sources of bias -- the inconsistent year range -- as well as for a few incorrect data points found in the underlying data used in the BiOp. [\*121] Doc. 540 at ¶¶ 17-18. This revised analysis, which is presented in Exhibit 2, Figure 2 to Mr. Hilts' declaration, is replicated below:



Doc. 540, Exhibit 2, Figure 2. According to Mr. Hilts, this figure demonstrates the "same general upstream movement" of X2 "discussed in the 2008 BiOp." *Id.* at ¶ 17. <sup>26</sup>

<sup>25</sup> Mr. Hilts chose to use KM instead of ANN because "[w]orking with ANN is very complex"; "using ANN to estimate X2 had just been introduced to Calsim II when the 2008 OCAP BA was

completed"; and "few outside DWR know how to work with [ANN]." Doc. 540 at ¶ 15.

26 Mr. Miller rejoins that Mr. Hilts' revised analysis contains several errors. *See* Doc. 597 at ¶ 18(b)-(c). Even assuming, *arguendo*, Mr. Hilts' analysis was accurately performed, the comparison of Calsim II to Dayflow generates significant bias that is not addressed in the BiOp.

Recognizing that his revised analysis demonstrates the same general upstream shift as the BiOp, Mr. Hilts criticizes Mr. Miller for failing to "quantify the effect of the alleged biases ostensibly embedded in the X2 comparison presented in the BiOp." *Id.* at ¶ 7. Federal Defendants contend that even if [\*122] the Calsim II to Dayflow comparison introduced bias, that bias was not significant. However, the record suggests otherwise.

Recognizing that it is not possible to quantify all aspects of the error caused by the comparison of Calsim II runs to Dayflow output, Mr. Miller's reply declaration endeavored to quantify the bias in his reply declaration. *See* Second Miller Decl., Doc. 597. As with Mr. Hilts' revised calculations, Mr. Miller compared the results reported in the BiOp (Calsim II runs applying the ANN equation and Dayflow runs using the KM equation), to a revised set of results using the KM equation instead [\*906] of ANN in the Calsim II runs. *Id.* at ¶ 14. Mr. Miller's analysis shows that project operations will cause an upstream shift in X2. Mr. Miller explained that the BiOp's comparison reflected a difference between the reported historic median of X2 [79 km] and the study 7.0 median [87 km] of 10% [(87 km - 79 km)/79]. Mr. Miller concluded that the median X2 for the CalSim 7.0 study using the KM equation (instead of using ANN) was 84 km (instead of 87 km). Finally, he identified the percent difference between the reported historic median estimate of X2 using the KM equation [79 km] [\*123] and the CalSim study 7.0 median estimate of X2 using the KM equation [84 km] to be 6% [(84 km-79 km)/79 km]. *Id.* at ¶ 14; BiOp at 235-36. From this, Mr. Miller concluded 40% of the difference between X2 as estimated by study 7.0 and the historical X2 baseline reported in the BiOp is error attributed entirely to the use of the KM equation to calculate the historical baseline X2 and the ANN equation to calculate the CalSim II study 7.0 results. *Id.* at ¶ 15. It is unknown which portion of the remaining 60% of difference is attributable to the proposed action, and which portion is due to the other identified biases. *Id.* at ¶ 16. Dr. Punt expressed a corroborating opinion, estimating that the bias created by failing to calibrate the models "seems non-trivial" and opining that it could be "as large as the differences seen in Figure E-19," the figure in the BiOp depicting the purported 10% shift in X2 between the historic/Dayflow runs and the Calsim II runs. Doc. 633-1 at 16.

Following a similar methodology, using the BiOp's Figure E-20 equation, Mr. Miller calculated the reduction in suitable habitat consistent with the change in the position of X2. A comparison of CalSim II study 7.0 with [\*124] study 7.1 yielded a reduction in habitat area of 128 hectares (or 2.8%), and a comparison of study 7.0 with study 8.0 yielded a reduction in habitat area of 289 hectares (or 6.2%). Doc. 597 at ¶ 20; BiOp at 266.

Mr. Miller opined that all errors/biases could have been avoided by comparing CalSim II study 7.0 -- designed as a current conditions baseline -- instead of the "historical" baseline in the BiOp, to the near-future 7.1 study. <sup>27</sup> However, Mr. Hilts points out that comparing Calsim II Study 7.0 to 7.1 and 8.0 is simply "not responsive to the need for comparisons with historical X2 locations," because none of the Calsim II simulations represent Delta conditions that existed from 1967 -2007. Doc. 540 at ¶ 9. "With the Fall X2 comparison, [FWS] wanted to investigate whether the continuation of the recent, as well as future, CVP/SWP operations would result in less or deteriorated habitat for delta smelt relative to the habitat that prevailed historically." *Id.* at ¶ 8. "The CalSim II simulations that Mr. Miller would have the FWS use do not" accomplish this. *Id.*

27 Mr. Miller performed a Calsim II to Calsim II comparison. The results indicate a 0.7 km upstream movement of X2, with a 0.8% [\*125] change in X2 from current to near-current conditions. In a comparison of Calsim II Study 7.0 to Study 8.0 (a 2030 level of development scenario), X2 moved upstream only 1.1 km (1.2 % change). Doc. 597 at ¶20; BiOp at 235, 265. In contrast, the BiOp estimated approximately 8.7 km and 9.1 km changes, respectively, using Dayflow data as the baseline. BiOp at 265 (Figure E-19).

The theoretical problems with using a Calsim II to Calsim II comparison were manifest. As discussed above, when CalSim II was used to model current Project operations, and these results were then compared to the results of a CalSim II modeling run purportedly simulating past operations, the results "were nearly identical" despite significant operational changes in current operations as compared to past. BiOp at 204-205. The BiOp explains that " [\*907] [t]he inaccuracies in CalSim [led FWS] to use actual data to develop an empirical baseline." *Id.* at 206. <sup>28</sup> FWS contends it had legitimate reasons to rely on a Calsim II to Dayflow comparison instead of a Calsim II to Calsim II comparison.

28 The Independent. Peer Review of the BiOp's Effects Analysis also noted and was "surprised at" the fact that the historical baseline "differed [\*126] greatly" from CalSim II Study 7.0 simu-

lated results. AR 008817. The Peer Review reasoned that this discrepancy "raises the question of how representative Study 7.0 is of current and near-future conditions." *Id.*

In light of the known and material resulting disparity, FWS's decision to use a Calsim II to Dayflow comparison to quantitatively justify its jeopardy and adverse modification conclusions, without attempting to calibrate the two models or otherwise address the bias created, was arbitrary and capricious and ignored the best available science showing that a bias was present. The BiOp specifically relied upon the quantitative nature of the Calsim II to Dayflow comparisons in many places. For example, in reference to the X2 shift and resulting effects on smelt habitat:

The median X2 across the CALSIM II modeled scenarios were 10-15 percent further upstream than actual historic X2 (Figure E-19). Median historic fall X2 was 79km, while median values for the CALSIM II modeled scenarios ranged from 87 to 91km. The CALSIM II modeled scenarios all had an upper range of X2 at about 90km. The consistent upper cap on X2 shows that water quality requirements for the Delta ultimately constrain [\*\*127] the upper limit of X2 in the simulations. These results were also consistent across WY types (Figure E-19) with the differences becoming much more pronounced as years became drier. Thus, the proposed action operations will affect X2 by shifting it upstream in all years, and the effect is exacerbated in drier years.

BiOp at 235. The BiOp does not explain to what extent the ultimate jeopardy/ adverse modification conclusions were based upon the calculated magnitude (10-15 percent) of the X2 shift, rather than the existence of a shift. It cannot be determined whether the BiOp would have reached the same conclusion had this bias not been present.

Federal Defendants concede but understate that "the two models are not perfectly calibrated, and a slight transformation of the data occurs when the analysis switches from one model to the other, the BiOp acknowledges this slight shift." Doc. 660 at 36. Nevertheless, FWS concluded in its "scientific judgment [] that the CalSim [II]-to-Calsim [II] output was far worse." *Id.* (citing BiOp at 207). Federal Defendants argue this was a choice between "one comparison that yielded a slight

calibration issue and another that completely masked altogether [\*\*128] the variable sought to be compared...." and that "it would have been irrational for the Service to proceed with [a Calsim II to Calsim II comparison] after discovering its flaws. *Id.* This may be the case, but it does not follow that what FWS did with the Calsim II to Dayflow comparisons was rational or based upon the best available science.

FWS had actual notice of scientific concerns with comparing historical data to CalSim II simulated data. DWR Deputy Director Jerry Johns, on October 24, 2008, submitted comments to FWS on the draft effects analysis, generally cautioning against the comparison of modeled data with actual data:

USFWS is using historic data for comparison to CalSim II simulations. Great [\*\*908] caution should be taken when comparing actual data to modeled data. CalSim II modeling should be used in a comparative mode. In other words, it should be used to compare one set of model runs to another. For example, it would be appropriate to compare CalSim II modeling of one demand alternative to another to analyze the incremental effects.

AR 008671; *see also* AR 008668 (further explaining unreliability problems comparing historic and modeled data). Although neither Mr. Miller nor any [\*\*129] interested party suggested that comparing Dayflow to Calsim II data was a scientifically invalid methodology prior to the issuance of the BiOp, the BiOp does not recognize the essential methodological defect, or explain how any of the conclusions it reached account for it. Nor does the BiOp explain how it is able to attribute the changes in X2 it found between the "historic" baseline and the CALSIM studies to the proposed action, and not to any of the other differences between the Dayflow and Calsim II models. Instead, FWS only rationalizes that it opted to use the "historic" baseline rather than CALSIM Study 7.0 as the baseline because, "the CALSIM monthly simulation model does not capture a precise Delta operation.... [Thus], the inaccuracies in CALSIM lead us to use actual data to develop an empirical baseline." BiOp at 204 & 206. This statement may explain the reasons for FWS's decision, but it does not justify its ultimate conclusion.

This is of particular concern because DWR, a joint operator of the projects communicated its scientific and operational concerns based on known available science. DWR and Reclamation have legal obligations to allocate water supply reasonably and responsibly, [\*\*130] not solely to save the species. As discussed in below at Part

VII.B, FWS's focus on its responsibilities to the species appears to have caused it to ignore its own regulations' obligations to consider impacts to the overall water supply and additional uses. The potential impacts of inaccurate quantitative analyses in the BiOp cannot be understated.

Defendants argue FWS's decision to compare the two models to quantify the shift of X2 was a reasonable scientific decision, even though other experts may disagree. Doc. 660 at 17-19; Doc. 661-3 at 13-14. Federal Defendants cite *Lands Council*, 537 F.3d at 993, to justify FWS's modeling decisions as entitled to deference, because it is a matter "within its area of special expertise, at the frontiers of science." <sup>29</sup> As a general rule, choices regarding modeling methods are exactly the sort of choices that, under the APA, are left to the expert agency in the exercise of its discretion. *NWF v. EPA*, 286 F.3d at 565. [\*922] A court "may reject an agency's choice of a scientific model only when the model bears no rational relationship to the characteristics of the data to which it is applied." *Id.* at 565 (internal quotations and citations omitted). *Lands* [\*131] *Council* instructs [\*909] that a court is "not free to impose on the agency [its] own notion of which procedures are best.... Nor may [it] impose procedural requirements not explicitly enumerated in the pertinent statutes." 537 F.3d at 993 (internal citations and quotations omitted); *id.* at 1000 (finding agency did not act arbitrarily "in relying on its own data and discounting the alternative evidence offered" by plaintiffs because "[w]hen specialists express conflicting views, an agency must have discretion to rely on the reasonable opinions of its own qualified experts even if, as an original matter, a court might find contrary views more persuasive") (citations omitted).

29 *Lands Council* also held that an agency is not required "to conduct any particular test or to use any particular method, so long as 'the evidence ... provided to support [its] conclusions, along with other materials in the record,' ensure that the agency 'made no clear error of judgment that would render its action arbitrary and capricious.'" *League of Wilderness Defenders-Blue Mountains Biodiversity Project v. U.S. Forest Serv.*, 549 F.3d 1211, 1218 (9th Cir.2008) (quoting *Lands Council*, 537 F.3d at 993). But *Lands Council* [\*132] and *Blue Mountains Biodiversity Project* arose under the National Forest Management Act ("NMFA") and/or the National Environmental Policy Act ("NEPA"), neither of which include the additional requirement, found in the ESA, that the agency use the "best available science." Although *Lands Council*'s general holding that a court must be deferential to an agency's choice of methodology in an area of its expertise, the

agency is not free to ignore the best available science.

In *NWF v. EPA*, the EPA evaluated several regulatory options for economic feasibility, applying a particular model to predict whether businesses were likely to go bankrupt under the weight of additional regulation. *NWF* criticized the model on several grounds, including that the model had "an error rate of at least 15%." *Id.* at 565. The D.C. Circuit examined and rejected each critique, reasoning that none called into question the model's reliability. *Id.*

Here, however, undisputed expert testimony offered by DWR, a co-operator of the Projects, calls into question the manner by which FWS utilized the two models to evaluate the impact of project operations on the position of X2. The Calsim II model was developed [\*133] by DWR and Reclamation as a planning tool to simulate State Water Project and Central Valley Project operations. DWR, one of the agencies with special expertise in the use and application of Calsim II, *see* BiOp at 207; Miller Decl., Doc. 548-1, at ¶ 5-7, raised cautions and objects to the manner in which FWS used the model. Federal Defendants do not rebut the undisputed expert evidence that using such comparisons for quantitative purposes is scientifically improper. All experts in this case agree that data from two different models should not be compared without calibration. Doc. 633-1 at 13-17 (706 expert report); Miller Decl., Doc. 548-1, ¶¶ 22-55; Second Miller Decl., Doc. 597, ¶¶ 4-22. In other words, even though no superior set of models have been identified, the chosen models were indiscriminately used without addressing an important factor, the potential (and apparently real and significant) bias created when the results of two different computer models were used to perform quantitative comparisons. Unlike *NWF v. EPA*, where the agency applied a model that was deemed reliable, here, FWS has not addressed or explained the material bias created by its methodological choices. It [\*134] cannot be determined whether FWS would have reached the same result had the bias been considered or addressed. FWS must do so on remand.

(2) Does the Use of Dayflow to Represent the Baseline in the Project Effects Analysis Improperly Attribute Past Effects to the Projects?

DWR asserts that FWS's use of an "historical baseline" was per se unlawful because the ESA's implementing regulations "require the Service to use current operations, not past operations, as the baseline for its effects analysis." Doc. 548 at 7-8. In support of this contention, DWR cites 50 C.F.R. § 402.02, which defines the "environmental baseline" to include:

the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section [\*910] 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process.

See also Consultation Handbook at 4-22 (baseline includes "effects of past and ongoing human and natural factors leading to the current status of the species") (emphasis added). In addition, DWR cites *NWF v. NMFS II*, 524 F.3d at 930, [\*\*135] which held that an agency action "only 'jeopardize[s]' a species if it causes some new jeopardy." (Emphasis added.) DWR argues that "[b]ecause [FWS's] baseline looks to decades past, it cannot be used as a basis for assessing any 'new jeopardy' posed by Project operations going forward." Doc. 548 at 8.<sup>30</sup>

30 Plaintiffs advance the related argument that FWS's use of a historic baseline caused FWS to mix the effects of the OCAP with the effects of all the other changing factors that occurred during the historical period of 1967 to 2007 represented by the Dayflow data. Doc. 551 at 24. However, the post-record expert testimony provided in support of this argument was stricken. Doc. 750 at 3, at ¶9.

DWR oversimplifies the issue. FWS's BiOp sought to determine whether ongoing and future coordinated operations of the CVP and SWP would cause jeopardy to the delta smelt or adversely affect its critical habitat. Arbitrarily setting the baseline at 2008, when the BiOp's analysis was finalized, would not have captured the impacts of then-ongoing project operations. The agency had discretion to use a historic baseline.

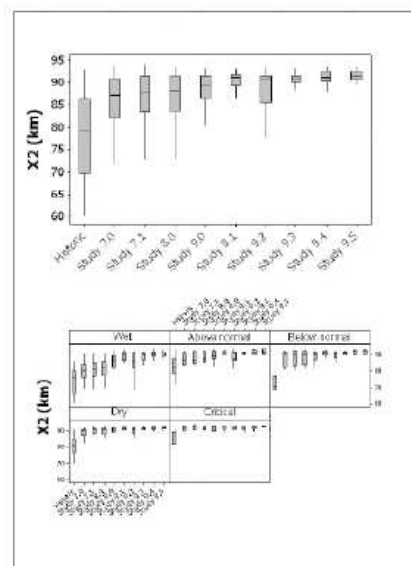
(3) Use of Comparisons Between CALSIM and DAYFLOW Model Outputs to Justify Imposition [\*\*136] of Component 3 (Action 4), the Fall X2 Action.

In addition to utilizing comparisons of Calsim II and Dayflow data in the Project Effects section to demonstrate that Project Operations affect the location of X2, the BiOp relies on these comparisons to justify the imposition of RPA Component 3 (Action 4, or the "Fall X2 action"). The BiOp's "Justification" section discussing Action 4 references the Calsim II to Dayflow comparison:

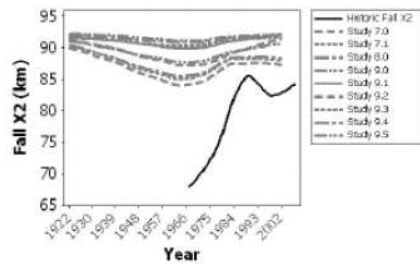
The Effects section clearly indicates there will be significant adverse impacts on X2, which is a surrogate indicator of habitat suitability and availability for delta smelt in all years (Figures E-19 and E-25 in Effects section).... The action is focused on wet and above normal years because these are the years in which project operations have most significantly adversely affected fall (Figure E-27 in Effects section) and therefore, actions in these years are more likely to benefit delta smelt.

BiOp at 373. Figures E-19 and E-25 compare historic X2 locations simulated by Dayflow to conditions under planned project operations simulated by Calsim II:

[\*911] Figure E-19. X2(km) during September to December based on historic data and CALSIM H model iconics. The center line [\*\*137] in the box is the median and the outer box boundaries are the first and third quartiles.



[\*912] Figure E-25. Smoothed trend lines for the time series of historic and CALSIM II-modeled fall X2.



BiOp at 265, 271.

Undisputed expert testimony establishes the likelihood that the comparison of Dayflow to Calsim II data introduced significant error into the analysis that forms the basis for Figures E-19 and E-25. Mr. Miller concluded 40% of the difference between X2 as estimated by study 7.0 and the historical X2 baseline reported in the BiOp is error attributed entirely to the use of the KM equation to calculate the historical baseline X2 and the ANN equation to calculate the CalSim II study 7.0 results. Second Miller Decl., Doc. 597, at I 15. It is unknown which portion of the remaining 60% of difference is attributable to the proposed action, and which portion is due to the other identified biases. *Id.* at ¶ 16. Dr. Punt gave a consistent opinion, estimating that the bias created by failing to calibrate the models "seems non-trivial" and opining that it could be "as large as the differences seen in Figure E-19," the figure in the BiOp depicting the shift [\*\*138] in X2 between the historic/Dayflow runs and the Calsim II runs. Doc. 633-1 at 16.

Federal Defendants do not respond directly to these assertions of bias. Instead, they point out that the historical X2 data was not the only basis for Action 4. Doc. 660 at 49. The BiOp describes multiple sources of information that were considered:

This analysis of the effects [of the] proposed CVP and SWP operations on the delta smelt and its critical habitat uses a combination of available tools and data, including the CALSIM II model outputs provided in the appendices of Reclamation's 2008 Biological Assessment, historical hydrologic data provided in the DAYFLOW database, statistical summaries derived from 936 unique 90-day particle tracking simulations published by Kimmerer and Nobriga (2008), and statistical summaries and derivative analyses of hydrodynamic and fisheries data provided by Feyrer et al. (2007), Kimmerer (2008),

and Grimaldo, et al. (accepted manuscript).

BiOp at 204; *see also* Feyrer Decl., Doc. 541, at I 17. Additionally, "[t]he Service's [\*913] examination of habitat suitability during fall is derived from published literature and unpublished information linking X2 to the amount of suitable [\*\*139] abiotic habitat for delta smelt (Feyrer et al. 2007, 2008)." BiOp at 234. The BiOp expressly recognizes that the modeling does not precisely represent historic X2, as do the peer-reviewed studies on which the BiOp relies in part for this component. *See* BiOp at 204; AR 018278-018306 (Feyrer, *et al.* (2008)).

The justification for Action 4 relies heavily on the quantitative analyses presented in Figures E-19 and E-25. *See* BiOp at 373. Whether Action 4, which has substantial adverse impacts on the water supply, is justified in the absence of the quantitative analysis cannot be determined. These questions are too serious to go unanswered and must be remanded to the agency for further explanation and/or correction.

### (3) Other Challenges to the Fall X2 Action.

Plaintiffs raise additional challenges to the justification for the Fall X2 action, arguing "neither the BiOp nor the record demonstrate that Component 3 (Action 4) is necessary to avoid jeopardy to the delta smelt or destruction or adverse modification of its critical habitat, or that it will materially benefit the species or its habitat." Doc. 697 at 25.

a. Plaintiffs' Argument that Action 4 is an "Untested Hypothesis."

Plaintiffs maintain [\*\*140] that Action 4 is nothing more than an "untested hypothesis," emphasizing that FWS acknowledges the need to assess the efficacy of Action 4 over time:

The Service shall conduct a comprehensive review of the outcomes of the Action and the effectiveness of the adaptive management program ten years from the signing of the biological opinion, or sooner if circumstances warrant. This review shall entail an independent peer review of the Action. The purposes of the review shall be to evaluate the overall benefits of the Action and to evaluate the effectiveness of the adaptive management program. At the end of 10 years or sooner, this action, based on the peer review and Service de-

termination as to its efficacy shall either be continued, modified or terminated.

BiOp at 283.

This does not render Action 3 a mere "hypothesis," nor does this "demonstrat[e] the absence of a rational connection between Action 4 and an increase in smelt abundance." Doc. 697 at 25. It is not inconsistent to find an action necessary, while also calling for an evaluation whether that action actually produced the expected outcomes. It is of no moment that in a research paper Mr. Feyrer referred to the X2 requirement as "the [\*\*141] hypothesis that the combined effects of pre-adult abundance and the amount of suitable abiotic habitat (or X2) during autumn affect recruit abundance the following summer." AR 018285 (Feyrer unpub. 2008). He is a scientist gathering further information about the relationship between X2 and smelt population dynamics. The record does not suggest this is scientifically improper. It was not clearly erroneous for FWS to rely upon Feyrer's 2008 research paper.

b. FWS' Reliance on the Feyrer Papers.

FWS based its effects analysis of X2 in part <sup>31</sup> on two articles written by Feyrer et al. [\*\*914], which purported to show a correlation between X2 in the autumn and subsequent delta smelt abundance. *See* BiOp at 235-38 (citing Feyrer et al. (2007); Feyrer et al. (2008)). Plaintiffs argue that these articles did not represent the best available science because "the correlation they claimed to find was driven by the presence of a single unrepresentative data point." Doc. 551 at 34. Even assuming the scientific validity of the 2007 and 2008 Feyrer analysis, Plaintiffs contend the BiOp's X2 conclusions far exceed what the articles scientifically support. *Id.*

31 Plaintiffs argue that "FWS based its effects analysis [\*\*142] of X2 entirely on two articles written by Feyrer, et al." Doc. 551 at 34 (emphasis added). Federal Defendants point to pages 152 to 179 of the BiOp to demonstrate that FWS considered a broad range of other materials in analyzing X2. However, these pages are not part of the BiOp's Effects Analysis nor the description and justification for Action 4. Rather, they describe FWS's view of the delta smelt's status and description of the environmental baseline. The portion of the BiOp that actually examines the purported relationship between X2 and smelt habitat states that FWS's "evaluation of habitat suitability considered three specific elements: X2, total areas of suitable abiotic habitat, and the pre-

dicted effect on delta smelt abundance the following summer." BiOp at 234-35. The description of the first of these three elements refers to the "CALSIM II modeled results" and "Feyrer 2007, 2008." BiOp at 235. Similarly, the second step of the evaluation, modeling the location of X2 purportedly to determine the "total surface area of suitable abiotic habitat," also relied on "modeled X2" and the Feyrer 2008 paper. BiOp at 235. Finally, in the third step of the evaluation, FWS allegedly used [\*\*143] the modeled X2 data to estimate the effect of Project operations on delta smelt abundance. BiOp at 236. This third step cited extensively to the Feyrer (2007) article and a Feyrer 2008 paper, along with a citation to Bennett (2005). Facially, the X2 analysis relied on the modeled X2 data, Feyrer's work, and Bennett's 2005 paper.

Plaintiffs suggest that the modeled X2 data did not constitute a separate justification for Action 4 because the reason FWS gave in the BiOp for presenting the Calsim II model results in a monthly time step was "to be consistent with previous analyses (Feyrer 2007, 2008)." BiOp at 235. But, this does not mean that the Calsim II data was somehow dependent upon Feyrer's work. Rather, that data was presented in such a way to be consistent with the way Feyrer analyzed data. In the final analysis, Action 4 did rely extensively, but not exclusively, on Feyrer's articles.

Plaintiffs' letter, responding to a draft of the BiOp, identified a purported flaw in the Feyrer et al. (2008) analysis: the supposed correlation between Fall X2 and delta smelt abundance Feyrer et al. was driven by the presence of a single, apparently outlier, data point. Removing that data point [\*\*144] resulted in a finding of no statistically significant relationship between Fall X2 and the abundance of delta smelt. *See* SLDMWA & SWC Letter to NMFS and FWS (Oct. 20, 2008) at 2 (AR 006407). As the letter noted, "a correlation solely reliant upon a single data point cannot reasonably be considered as an actual indicator of cause." *Id.* Plaintiffs' argument continues:

That there was no statistically significant relationship between X2 and delta smelt abundance during the 1987-2007 period should not have been surprising given that Feyrer et al. found no statistically significant relationship between the two factors for the 1968-1986 period or for the entire 1968-2007 period. Feyrer et al. (2008) at 14 (AR 018291). Nor was it

surprising considering that--as the Feyrer et al. (2008) article conceded--the existing best available science on delta smelt showed no direct correlation between the location of Fall X2 and delta smelt abundance. Feyrer et al. (2008) at 8 ("[P]revious analyses have not shown simple relationships between X2 and delta smelt abundance.") (AR 018285).

Doc. 551 at 35.

Federal Defendants respond:

[U]less data points are excluded to control for a specific variable, or for some [\*\*145] other explicit reason that is central to measuring the relationship at issue, [\*915] there is no scientific reason to remove a data point from an analysis just because it changes the result. In any event, removing the data point challenged by Plaintiffs does not appreciably change the result - the result goes from a 95% probability the relationship is not due to chance to a 92% probability that the relationship is not due to chance. Moreover, this is an argument that can go both ways. Removing other individual data points would increase the statistical significance.

Doc. 660 at 44. Federal Defendants are correct that removing a data point simply because it changes the result would be arbitrary. Plaintiffs do not point to any scientific basis, let alone an undisputed one, for excluding the so-called "outlier" point, other than that it is an outlier. Plaintiffs do not show the point is erroneous or identify competing studies that reach different opinions from Feyrer that FWS failed to consider. This is a scientific dispute among experts over which the agency is owed deference.

c. Do [\*\*146] the Studies Cited in the BiOp Support FWS's Conclusion that Fall X2 Determines the Extent of Suitable Smelt Habitat?

The BiOp concludes that to avoid jeopardy the RPA Actions must "[i]mprove fall habitat for delta smelt by managing [ ] X2 through increasing Delta outflow during fall when the preceding water year was wetter than normal." BiOp at 369; *see also* BiOp at 374 ("Outflow during fall determines the location of X2, which determines the amount of suitable abiotic habitat available to delta

smelt (Feyrer et al. 2007, 2008)."). Plaintiffs argue that none of the articles FWS cited in the BiOp actually support FWS's conclusion that the location of X2 determines the amount of suitable habitat for the delta smelt. *See* Doc. 551 at 39-41.

(1) Feyrer (2007).

Plaintiffs first criticize the BiOp's reliance on a 2007 Canadian Journal of Fisheries and Aquatic Sciences paper by Feyrer, Nobriga, and Sommer, three scientists then working for Plaintiff DWR, entitled, "Multidecadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA." AR 018266-77. That paper used a generalized additive model to assess the relationship between changes [\*\*147] in environmental quality for delta smelt (particularly salinity and turbidity) and the abundance of delta smelt. *Id.*

The paper demonstrated that a statistically significant relationship existed between salinity and turbidity in the fall months and the abundance of juvenile delta smelt the following summer for the period of 1987-2004. *Id.* This time period was chosen because it corresponded to the invasion of the *Corbula amurensis* clam which has resulted in significant ecological changes to the Delta. AR 018270. The results demonstrated that 63 percent of sampling stations showed statistically significant declines in environmental quality in the fall, with the western and southeastern regions of the Delta suffering the most substantial long term declines in habitat quality, while the area at the confluence of the Sacramento and San Joaquin Rivers least affected by the changes in fall habitat quality. *Id.*

The Feyrer (2007) analysis uses the results of a 2005 study by William Bennett published in the Journal of San Francisco Estuary and Watershed Science, which concluded: "Factors defining the carrying capacity for juvenile delta smelt are unknown, but may include a shrinking volume of physically [\*\*148] suitable habitat combined with a high density of competing [\*916] planktivorous fishes during late summer and fall." AR 017004.

The BA acknowledged the results of this 2007 study, including the conclusion that fall habitat conditions have population level effects:

Based on a 36-year record of concurrent midwater trawl and water quality sampling, there has been a long-term decline in fall habitat environmental quality for delta smelt (Feyrer et al. 2007). The long-term environmental quality declines for delta smelt are defined by a lowered probability of occurrence in samples based on

changes in specific conductance and Secchi depth. Notably, delta smelt environmental quality declined recently coinciding with the POD (Figure 7-8). The greatest changes in environmental quality occurred in Suisun Bay and the San Joaquin River upstream of Three Mile Slough and southern Delta (Figure 7-9). There is evidence that these habitat changes have had population-level consequences for delta smelt. The inclusion of specific conductance and Secchi depth in the delta smelt stock-recruit relationship described above improved the fit of the model, suggesting adult numbers and their habitat conditions exert important [\*\*149] influences on recruitment.

AR 010626; *see also* AR 010628-29 (reproducing maps and graphics showing habitat declines and geographic distribution of declines from Feyrer (2007)).

The conclusions in Feyrer (2007) were also recognized in the January 2008 report on the Pelagic Organism Decline by the Interagency Ecological Program, which reached nearly identical conclusions about the effects of declining fall habitat quality on delta smelt abundance. *See* AR 016938, 016954, 016957.

Plaintiffs level several criticisms at Feyrer (2007) and the BiOp's use of the study. First, Plaintiffs complain that the Feyrer study "repeatedly states that the article supports only the 'hypothesis' that EQ (a metric devised by Feyrer that incorporates two factors - secchi depth and temperature - in addition to salinity) is 'an important predictor of delta smelt abundance during the 1987-2004 post-*Corbula* period.'" Doc. 697 at 29 (citing AR 018271). The use of the term "hypothesis" does not undermine Feyrer's conclusions, as articulating a hypothesis is a step in the scientific method.

Plaintiffs next point out that while Feyrer (2007) found a statistically significant relationship between the location of X2 and [\*\*150] delta smelt abundance from 1987-2004, there was no statistically significant correlation for the twenty years prior to *Corbula's* arrival (1968-1986). AR 018271. The article acknowledged "[b]iotic variables, most notably competition, predation, and food availability, could have also played a major role in controlling the distribution" of delta smelt and "[t]he recent step change in the abundance of pelagic fish suggests that salinity alone may not be sufficient to explain long-term trends in estuarine management." AR 018275. The article confirms that even when considering specific conductance (i.e., X2), secchi depth, and temperature

together, those three factors collectively only predict 25.7% of future delta smelt occurrence. AR 018271. Finally, the article concludes that "the degree to which EQ could be used for management purposes remains unclear." AR 018275.

*Tucson Herpetological Society*, 566 F.3d 870, held that an agency may not rely on "underdeveloped and unclear" studies to support ESA findings. There, an earlier FWS finding concluded that population dynamics information for the flat-tailed horned lizard was "limited and inconclusive." *Id.* at 878. Nevertheless, FWS relied on [\*\*151] these uncertain studies to infer that [\*\*917] the lizard population remained viable throughout most of its range. *Id.* The Ninth Circuit found that FWS's "affirmative[] reli[ance] on ambiguous studies as evidence of persistence..." to be unreasonable because "the studies do not lead to the conclusion that the lizard persists in a substantial portion of its range and therefore cannot support the Secretary's conclusion." *Id.* at 879.

FWS's reliance on Feyrer (2007) is distinguishable. Although Feyrer (2007) acknowledges that multiple factors may be contributing to the delta smelt's decline, the study affirmatively finds a statistically significant, albeit limited, correlation between the fall location of X2 and subsequent delta smelt abundance. This finding is not uncertain. It acknowledges the context of a complex ecosystem in which many factors may impact the species. Feyrer's X2 analysis explains only 25.7 percent of subsequent year abundance. This is not a *de minimis* impact. (It goes, rather, to the agency's overemphasis on X2 to impose a significantly restrictive fall RPA component.) Plaintiffs cite no studies that demonstrate the cause of the remaining 74.3 percent variation in abundance. [\*\*152] FWS's reliance on Feyrer (2007) was not *per se* unreasonable, however, FWS's use of the study to justify operational restrictions is more questionable.

## (2) The Feyrer (2008) Paper.

A 2008 paper by the same authors (Feyrer, Nobriga, Sommer), along with Ken Newman of FWS, appeared in the *Estuaries and Coasts* journal. *See* AR 018278-306. This expanded upon the 2007 research, used statistical analyses, including both Ricker and Beverton-Holt type models, to compare Fall X2, habitat area for and subsequent abundance of delta smelt. *Id.* Like Feyrer (2007), it concluded that fall habitat quality had a statistically significant effect on subsequent delta smelt abundance, determining that the model incorporating prior abundance and X2 accounted for 66 percent of the variability in subsequent abundance. *Id.* The authors identified a number of reasons why the location and extent of fall habitat affected subsequent abundance:

First, positioning X2 seaward during autumn provides a larger habitat area which presumably lessens the likelihood of density-dependent effects (e.g., food availability) on the delta smelt population. For example, food availability during autumn for adult haddock (*Melanogrammus* [\*\*153] *aeglefinus*) likely improves juvenile recruitment the following year (Friedland et al. 2008). Second, a more confined distribution may increase the probability of stochastic events that increase mortality rates of adults. For delta smelt, this includes both predation, as well as anthropogenic effects such as contaminants or water diversion loss (Sommer et al. 2007).

AR 018293. The study concluded: "Comparing the first ten years of the time series to the last ten years, the amount of suitable abiotic habitat for delta smelt during autumn has decreased anywhere from 28% to 78%, based upon the least and most restrictive habitat definitions, respectively." AR 018293-94.

Like Feyrer (2007), Feyrer (2008) narrowly considered abiotic factors alone, and limited its focus on X2. Feyrer (2008) concludes that manipulating X2 might affect delta smelt populations, but that "the specific mechanisms by which X2 affects delta smelt remain poorly understood." AR 018294. Because of this uncertainty, Feyrer (2008) recommended that any "real world" applications of [its] results should incorporate an adaptive management approach, allowing resource manager[s] to adjust actions in response to new [\*918] data collected [\*\*154] on delta smelt habitat conditions and use." *Id.*

Other than arguing that Feyrer (2008), like Feyrer (2007), used the "outlier" data point, Plaintiffs submitted no other substantive criticism of Feyrer (2008). FWS made no error in considering Feyrer (2008).

### (3) The Bennett (2005) Article.

Plaintiffs criticize the BiOp's citation of Bennett (2005), because, like the Feyrer studies, this article does not conclude that salinity or the location of X2 is a determinative factor in delta smelt abundance. Bennett (2005) specifically addresses: "[w]hat is the impact of human activities, particularly water export operations, on population abundance?" AR 017061. Bennett (2005) surveyed available data and concluded: "[t]his synthesis of the available information cannot answer th[is] vital management question." AR 017062. "The lack of appro-

priate data ... impedes efforts to resolve th[is] issue ...." AR 017004.

The BiOp does not rely on Bennett (2005) as the "be all end all" to address the management question. The BiOp cites Bennett (2005) for a series of factual assertions, including the premise that: "There is a statistically significant stock-recruit relationship for delta smelt in which pre-adult [\*\*155] abundance measured by the FMWT positively affects the abundance of juveniles the following year in the TNS." BiOp at 178. Plaintiffs do not disagree that Bennett supports this assertion. *See* AR 017035 (reviewing various studies finding a relationship between X2 position and smelt abundance). Plaintiffs have not demonstrated that the BiOp misrepresented Feyrer (2007), Feyrer (2008), or Bennett (2005), or that any of these studies are not part of the best available science.

### d. Does the Best Available Science Support the Assumption that X2 Is a Surrogate for Smelt Habitat?

Plaintiffs object that FWS' use of X2 as a "surrogate" indicator for delta smelt habitat suitability is not supported by the best available science, arguing: "FWS stretched the limited findings of Feyrer et al. (2007 & 2008) far beyond defensible application, converting a tentative finding that the location of X2 might influence habitat suitability into a definite conclusion that X2 alone determines the area and extent of delta smelt habitat for delta smelt." Doc. 551 at 38.

Feyrer (2007) discussed its limitations: "[T]he degree to which EQ [Feyrer's three-part index of environmental quality, which included salinity] could [\*\*156] be used for management purposes is unclear.... salinity alone may not be sufficient to explain long-term trends in estuarine management." AR 018275. Feyrer (2008) concluded, "[o]ur results suggest that managing estuarine flow or X2 during autumn can have positive effects on delta smelt habitat and abundance." AR 018292. The FWS BiOp relied on these two studies to conclude: "Out-flow during fall determines the location of X2, which determines the amount of suitable abiotic habitat available to delta smelt (Feyrer et al. 2007, 2008)." BiOp at 374. This is one scientific interpretation of X2's role. It may be a "stretch" or unjustified expansion of Feyrer (2007) or Feyrer (2008), however, when all the disputed X2 studies are considered, X2 has a measurable effect on smelt abiotic habitat.<sup>32</sup>

32 The BiOp asserts that Component 3 will improve smelt habitat "quality and quantity" in the fall. BiOp at 282. Plaintiffs point out that FWS has explicitly recognized that delta smelt habitat must be defined to encompass, in addition to space and salinity, food, water, air, light, miner-

als, or other nutritional or physiological requirements; cover or shelter; sites for breeding; habitats that are protected [\*\*157] from disturbance or are representative of the historic geographical and ecological distributions of a species, including physical habitat, water, and river flow. 59 *Fed. Reg.* 65,256, 65,259 (Dec. 19, 2004). Plaintiffs complain that "X2 is a metric that describes only a two-dimensional space consisting of a particular salinity at a specific depth in the Delta's channels; it is not coterminous with the dynamic three-dimensional space that supports the abiotic and biotic components that define delta smelt habitat." Doc. 697 at 35. In support of this assertion, Plaintiffs refer to many statements in the studies cited in the BiOp, indicating that X2 does not explain all variability in delta smelt abundance and/or distribution. *Id.* Those very same studies and the BiOp acknowledge that, while X2 does not explain everything, it explains enough to consider X2 a proxy for critical habitat and to structure management prescriptions around X2. That X2 is an imperfect proxy is relevant to the degree of uncertainty and justification FWS provides for the specific RPA prescriptions imposed.

[\*919] a. Are Delta Smelt Habitat Limited?

Plaintiffs assert that FWS ignored available evidence SLDMWA and SWC presented [\*\*158] to FWS indicating that delta smelt are particularly unlikely to be habitat-limited, given their record low abundance. SLDMWA-SWC Letter at 5-6, AR 006410-006411.

It is unquestioned that delta smelt survey results show decreasing abundance throughout the 2000s, with their current abundance at a historic low. BiOp at 154. In addition, the BiOp notes that "most life stages of the delta smelt are now distributed across a smaller area than historically," and recognizes that this is likely due to multiple factors, including channelization, conversion of Delta islands to agriculture, water project operations, salinity, turbidity, high summer water temperatures, and predacious species. BiOp at 152-53, 157. Plaintiffs argue that "simply because the delta smelt may currently occupy lesser spatial area than they did previously, does not mean that forcing a relocation or expansion of X2 will impact the species beneficially or at all." Doc. 697 at 33. Most of Plaintiffs' evidence submitted to support this argument has been stricken. *See* Doc. 750 at I 8 (striking paragraphs 14-17 of the Declaration of Charles H. Hanson, Doc. 395). Plaintiffs insist that the BiOp itself admits that the delta smelt [\*\*159] is not currently habitat-limited, citing pages 237 and 374. Page 237 makes such an admission, but it is qualified:

Combined, these effects of project operations on X2 will have significant adverse direct and indirect effects on delta smelt. Directly, these changes will substantially decrease the amount of suitable abiotic habitat for delta smelt, which in turn has the possibility of affecting delta smelt abundance through the compensatory density-dependant mechanisms outlined above. Because current abundance estimates are at such historic low levels, compensatory density-dependence can be a serious threat to delta smelt despite the fact that the population may not be perceived to be habitat limited. It is clear from published research that delta smelt has become increasingly habitat limited over time and that this has contributed to the population declining to record-low abundance levels (Bennett 2005; Baxter et al. 2008; Feyrer et al. 2007, 2008; Nobriga et al. 2008). Therefore, the continued loss and constriction of habitat proposed under future project operations significantly threatens the ability of a self-sustaining delta smelt population to recover and persist in the Estuary at [\*\*160] abundance levels higher than the current record-lows.

(Emphasis added). Pages 374-75 state:

The persistence of this significant hydrologic change to the estuary threatens [\*920] the recovery and persistence of delta smelt. Outflow during fall determines the location of X2, which determines the amount of suitable abiotic habitat available to delta smelt (Feyrer et al. 2007, 2008). The long-term upstream shift in X2 during fall has caused a long-term decrease in habitat area availability for delta smelt (Feyrer et al. 2007, 2008), and the condition will persist and possibly worsen in the future. This alone is a significant adverse effect on delta smelt.

However, the problem is further complicated because there are several lines of published peer reviewed scientific research that link habitat alteration to the decline of delta smelt (Bennett 2005; Feyrer et al. 2007; Nobriga et al. 2008). An important point regarding this action is that because of the current, extremely

low abundance of delta smelt, it is unlikely that habitat space is currently a limiting factor. However, it is clear that delta smelt have become increasingly habitat limited over time and that this has contributed to the population [\*\*161] attaining record-low abundance levels (Bennett 2005; Baxter et al. 2008; Feyrer et al. 2007, 2008; Nobriga et al. 2008). Further, as detailed in the Effects section, persistent degraded or worsened habitat conditions are likely to contribute to compensatory density-dependent effects on the delta smelt population while it is at historical low levels, and would at some point in the proposed term of this project, limit delta smelt recovery.

While "admitting" that the delta smelt may not be habitat-limited, the smelt has become "increasingly habitat-limited over time," contributing to the population's decline, and that worsening habitat conditions may limit smelt recovery. Plaintiffs have not presented any record best available scientific evidence not considered by FWS that contradicts this conclusion.

**b. FWS' Use of a Linear Model Instead of a Multiplicative Stock-Recruit Model .**

Plaintiffs next argue that FWS committed a serious scientific error by employing a linear additive model to determine the effect of Fall X2 on delta smelt abundance. See BiOp at 268, Figure E-22. Dr. Deriso opines that FWS' use of the linear additive model ran counter to decades of established scientific consensus [\*\*162] that linear models are not effective for modeling fish populations. Deriso Decl., Doc. 396, at I 80. He claims that standard practice in fisheries management is to use a multiplicative stock-recruit model, such as the Beverton-Holt or Ricker models, both of which are among the standard tools of the relevant science. *Id.* at ¶ 83; see also Hilborn, Decl., Doc. 393, at ¶ 31.

The BiOp estimated the effect of X2 on delta smelt abundance by using an updated version of the linear-additive model developed in Feyrer (2008). BiOp at 236. The result was Fig. E-22, which shows a linear relationship between X2 and delta smelt abundance such that juvenile abundance (which is measured using the Spring Tow-Net Survey) is equal to the sum of a constant number, plus the previous year's Fall Midwater Trawl Survey (times a constant number), minus X2 (times a constant number). BiOp at 268. Put simply, FWS' calculation found that  $A = B + C - D$ . Deriso Decl., Doc. 396, at ¶ 78.

Dr. Deriso explains the two fundamental problems with using an additive model. First, a linear additive model can produce the biologically implausible result that the total absence of adults in one year (i.e., no mature smelt to mate [\*\*163] and lay eggs) could still result in the model indicating the presence of newborn smelt the next year. *Id.* at ¶ 80. As Dr. Deriso explains, this nonsensical result is the product of basic [\*\*921] mathematical structure: if  $A$  (number of juveniles) =  $B$  (constant) +  $C$  (adults) -  $D$  (Fall X2), then  $A$  can be positive even if  $C$  is zero, as long as  $B$  is larger than  $D$ . See *id.*

The second fundamental problem with a linear additive model is that it treats X2 as a purely "additive factor," meaning that an increase of X2 by one unit will always reduce the delta smelt population by a certain number, no matter how large or small the total population may be. *Id.* at ¶ 81. Dr. Deriso's critique implies that if changes in X2 are harmful to delta smelt, it is logical to expect that a change in X2 would affect a considerably higher absolute number of delta smelt in a population of 1,000,000 than in a population of 1,000. See *id.*

Use of a multiplicative stock-recruit model solves both of these deficiencies. *Id.* at II 84-85. Multiplicative models are the textbook standard for modeling fish and other populations. See Deriso Decl., Doc. 396, at ¶ 43 n.3 (citing a representative sample of studies making use of multiplicative [\*\*164] stock-recruit models); see also, e.g., Bennett (2005) at 28-29 (using a multiplicative stock-recruit model for smelt abundance), AR 017031-017032; see also Hilborn Decl., Doc. 393, at II 30-31. Multiplicative stock-recruit models are preferred because they can better reflect the biological realities and idiosyncrasies of the fish species of concern. See Deriso Decl., Doc. 396, at I 83. This is because survival processes are inherently multiplicative: the fraction of individuals that survive to a given age will naturally be the product of all of the previous daily survival rates since birth. *Id.* Dr. Hilborn opined that the linear additive "approach is totally inconsistent with accepted practice in population dynamics." Hilborn Decl., Doc. 393, at ¶ 30.

Plaintiffs point to several record documents critical of FWS's modeling approach. For example, several Plaintiffs sent comment letters recommending the use of a logarithmic model. See AR 006406. In addition, the Peer Review Panel expressed general concerns with the linear model, stating "the model may be inappropriate for the data being used." AR 008819.

FWS noted in the BiOp that although the regression model works for 56 percent of the [\*\*165] data points, the residuals are "not normally distributed." BiOp at 236. FWS continued, "[t]he pattern of the residuals suggests that some type of transformation of the data would help

to define a better fitting model (Figure E-22). This analysis did not explore different data transformations." *Id.* Plaintiffs maintain that "exploring" different data transformations would not require FWS to conduct independent studies or to develop any new types of mathematical models, but rather would only require plugging existing data into the standard model used by fisheries biologists throughout the world. *See* Deriso Decl. ¶ 89.

Federal Defendants respond that this critique is much ado about nothing because, even though linear additive models can produce "biologically infeasible results" in some situations, the data set employed in the BiOp could not have created such a problem. *See* Newman Decl., Doc. 484, at I 19 (explaining that "for the given range of FMWT index and X2 values, the model-fitted values remained positive" using the linear model). Dr. Newman opined that "linear models are often used as approximations to more realistic nonlinear models, and often over the range of covariate values [\*\*166] of interest the nonlinear model may in fact be relatively linear." *Id.*

[\*922] A court "may reject an agency's choice of a scientific model 'only when the model bears no rational relationship to the characteristics of the data to which it is applied.'" *NWF v. EPA*, 286 F.3d at 565; *see Nat'l Ass'n of Metal Finishers v. EPA*, 719 F.2d 624, 657 (3rd Cir. 1983) ("the choice of scientific data and statistical methodology to be used is best left to the sound discretion of the [agency]") *rev'd* on other grounds *sub nom.*, *Chem. Mfrs. Ass'n v. NPJDC*, 470 U.S. 116, 105 S. Ct. 1102, 84 L. Ed. 2d 90 (1985).

Here, Plaintiffs critique raises a scientific dispute among experts. Dr. Newman's declaration provides evidence that the linear model used in the BiOp is not totally inappropriate. *See* Newman Decl., Doc. 484, at ¶ 19. It requires refinement, which FWS said it did. Newman's declaration also points out that the re-analysis by Dr. Deriso, using Deriso's model of choice, yields a result that also exceeds the 0.05 threshold of statistical significance. *Id.*

Feyrer's 2007 analysis was published in a peer-reviewed scientific journal. Although the BiOp's Effect's Analysis Peer Review questioned the model, the reviewers did not recommend that the [\*\*167] analysis or action be excluded; instead, that panel broadly supported implementation of the Fall X2 action, based in part on the analysis using the linear model, provided that the BiOp impose requirements for continued refinement of the analysis and implementation of the action by adaptive management. It is a close call. Absent agency bad faith, Plaintiffs have not established that this modeling dispute proves FWS violated the best available science standard.

c. DWR's Challenge to the BiOp's Choice of X2 Location.

RPA Component 3 (Action 4) requires the Projects to be operated to maintain X2 during the fall months at a location no greater than 74 km upstream from the Golden Gate Bridge following wet water years, and no greater than 81 km upstream following above normal water years. BiOp at 282-283. The rationale for this Component rests in large part on the Calsim II Dayflow comparison articulated in the Effects Analysis and discussed above. *See* BiOp 373-375, (explaining that the Effects section "clearly indicates there will be significant adverse impacts on X2"). As already determined, in the absence of calibration of the two models, the Calsim II to Dayflow comparison has the potential [\*\*168] to introduce significant, if not overwhelming, bias to the analysis that the BiOp nowhere discussed or corrected. The X2 action must be remanded to the agency for further consideration.

DWR also argues the X2 action is unlawful for a different reason, arguing that "[a]lthough the BiOp explains why Action 4 is to be implemented only in certain water year types, *see* BiOp 373-75, it fails completely to explain or justify the requirement that X2 be held at the locations specified." Doc. 548 at 9. Federal Defendants have not identified any record evidence that provides such an explanation. This total lack of explanation violates the APA's requirement that FWS "examine the relevant data and articulate a satisfactory explanation for its action including a rational connection between the facts found and the choice made." *Motor Vehicle Mfrs. Ass'n v. State Farm Mutual Auto. Ins. Co.*, 463 U.S. 29, 43, 103 S. Ct. 2856, 77 L. Ed. 2d 443 (1983). This failure also violates FWS's own Consultation Handbook implementing the ESA, which requires: "When a reasonable and prudent alternative consists of multiple activities, it is imperative that the opinion contain a thorough explanation of how each component of the alternative is essential [\*\*169] to avoid jeopardy and/or adverse modification." [\*923] ESA Handbook at 4-43. The BiOp violates this requirement because it fails to explain why it is essential to maintain X2 at 74 km and 81 km, respectively, as opposed to any other specific location.

#### (4) Challenges to Turbidity Trigger.

In their opening brief, Plaintiffs argue that one of the underlying tenants of Component 1 -- the link between turbidity and smelt presence -- has been "revealed as wholly arbitrary and capricious." Doc. 551 at 29. Action 1 of RPA Component 1 is triggered when "first flush conditions" occur, which are demonstrated by elevated river inflow and turbidity. BiOp at 280-81. The BiOp claims turbidity is an appropriate "on-ramp" indicator for

Action 1, because delta smelt presence and densities are correlated with turbid water, i.e., more delta smelt are found in turbid water than in clearer water, and so as turbid waters move towards CVP/SWP pumps, delta smelt must as well, which warrants severe pumping restrictions. *See* BiOp at 150-51, 280-81, 329-30.

Plaintiffs argue that after issuing the disputed BiOp and the RPA, FWS "recanted its confidence in the usefulness of turbidity as such an indicator" in a December 2009 [\*\*170] "Interim Federal Action Plan for the California Bay-Delta" ("Federal Action Plan") to which FWS was a signatory. Doc. 551 at 29. That Federal Action Plan, which was attached to the Declaration of Ronald Milligan<sup>33</sup> in Support of Federal Defendants' Opposition to Plaintiffs' Motion for Interim Remedy/Preliminary Injunction ("Milligan Decl."), Doc. 471, ¶ 11 & Exh. 3 at 10, contains the following discussion of a "2-Gates Fish Protection Demonstration Project":

[The P]roject was proposed as a scientific experiment to test the hypotheses that delta smelt follow turbidity and that smelt entrainment at the pumps could be prevented by keeping turbid water away from the pumps.... Once in place, the gates would be operated to reduce turbidity near the State and Federal pumps, and an evaluation could then be made of whether turbidity is, in fact, an accurate predictor of the presence of smelt.

*Id.* (emphasis added). Plaintiffs complain that "FWS cannot simultaneously view turbidity as only a hypothetical indicator of delta smelt presence, and also as a scientifically defensible basis to develop an RPA with significant water costs. The two positions are fundamentally contradictory, resulting in [\*\*171] an arbitrary RPA." Doc. 551 at 30.

33 Mr. Milligan is the Manager of Reclamation's Central Valley Operations Office, with responsibility for the day to day operations of the CVP. Milligan Decl., Doc. 471, at ¶ 1.

Plaintiffs are mistaken. First, the turbidity indicator is not an automatic trigger for RPA Component 1:

In order to prevent or minimize such entrainment, Action 1 shall be initiated on or after December 20 if the 3 day average turbidity at Prisoner's Point, Holland Cut, and Victoria Canal exceeds 12 NTU, or if there are three days of delta smelt salvage at either facility or if the cumulative daily

salvage count is above the risk threshold based upon the 'daily salvage index' approach described in Attachment B.... However, the SWG can recommend a delayed start or interruption based on conditions such as delta inflow that may affect vulnerability to entrainment.

BiOp at 281 (emphasis added).

FWS's reliance on turbidity as a potential indicator of smelt presence or movement was justified. The BiOp explains these physical conditions provide foraging, reproductive, and other behavioral and biological [\*924] benefits to delta smelt. Turbid waters make it more difficult for delta smelt to be [\*172] preyed upon, BiOp at 150-51, and also make it easier for delta smelt to forage for their prey, *id.* (citing 2004 study by Baskerville-Bridges). The preference of delta smelt for turbid waters has been verified in laboratory conditions with captive delta smelt, BiOp at 150 (citing a 2008 review by Nobriga and Herbold), and also in the field, where studies have observed "a negative correlation between the frequency of delta smelt occurrence in survey trawls during summer, fall and early winter and water clarity," *id.* (citing 2007 study by Feyrer and 2008 study by Nobriga). Increased turbidity is a documented indicator of improved habitat quality for delta smelt. Plaintiffs have provided any available science on the subject that was not considered. It was reasonable for the FWS to rely upon turbidity in RPA Component 1 as a potential predictor of delta smelt movement and adult delta smelt distribution.

The Federal Action Plan does not undermine this conclusion. As a threshold matter, the Plan is an extra-record document. Even if it were part of the record, it does nothing to call the FWS's reliance on turbidity into question. The quote from the Plan relied upon by Plaintiffs describes the [\*173] "2 Gates Fish Protection Demonstration Project," a forthcoming project designed to examine whether turbidity can be physically manipulated through barge-mounted gate structures, in an effort to keep delta smelt away from the influence of the pumps so that export pumping can be increased for the benefit of Plaintiffs and other agricultural concerns. Federal Action Plan at 10. The Action Plan will result in FWS and Reclamation continuing to study turbidity. *See* Federal Action Plan at 10-11 (announcing the publicly funded installation of an additional "14 real-time turbidity sensors in the Delta"). That further study is called for does not undermine the record evidence supporting the use of turbidity as an indicator.

Plaintiffs do not address the turbidity trigger in their reply brief. Federal Defendants' reliance on turbidity as one of several triggers for Action 1 was not arbitrary and capricious.

(5) Challenges to the Incidental Take Limit/Selective Use of Data.

Plaintiffs maintain Federal Defendants' failed to use the best available scientific data by selectively excluding data from certain parts of the BiOp, while including that data in other sections for different purposes. In particular, [\*\*174] Plaintiffs maintain that such selective use of data tainted: (1) the analysis of the effects of OMR flows on delta smelt; and (2) the formulation of the incidental take statement.<sup>34</sup>

34 The opening paragraph of the section of Plaintiffs' motion for summary judgment addressing the selective use of data also asserts that this practice tainted the BiOp's justification for monthly flow requirements under RPA Action 4 and examination of the effects to the species of exports of Article 21 water by the SWP. Doc. 551 at 25. However, these two additional arguments were not discussed or supported in the text of Plaintiffs motion. They will not be addressed.

a. FWS's Exclusion of Certain Data Points When Analyzing Entrainment.

On the impact of negative OMR flows on entrainment, the BiOp relies on a plot of the total number of salvaged adult delta smelt against OMR flows for the period from 1984 to 2007, BiOp at 164 (Figure S-8), and uses this plot to support the conclusion that entrainment of adult delta smelt rises with increasingly negative OMR [\*\*925] flows, *see* BiOp at 164-65, 348-49. It is also undisputed that FWS eliminated certain data from that plot, excluding data from the years 1987, 1989, 1990, [\*\*175] 1991, 1992 and 2007 because "low turbidity conditions" existed in Clifton Court Forebay. BiOp at 164.

This is explained in the graph itself. *Id.* (1987, 1989-92, 1994, and 2007 were excluded because those years exhibited low (<12ntu) average water turbidity during Jan-Feb at Clifton Court Forebay). The BiOp explains that turbidity is a potential indicator of smelt presence or movement. BiOp at 151. The BiOp presents defensible grounds for excluding these data points; Plaintiffs do not provide any evidence suggesting these exclusions were scientifically improper. There is no independent legal reason why FWS should be precluded from excluding certain data points if scientifically justified.

Under its mandate to utilize the best available science, FWS "cannot ignore available, relevant biological information." *Conner v. Burford*, 848 F.2d 1441, 1454 (9th Cir. 1988); *Kandra v. United States*, 145 F. Supp. 2d 1192, 1208 (D. Or. 2001). Plaintiffs cite *Sierra Club v. EPA*, 346 F.3d 955, 961 (9th Cir. 2003), for the proposition: "[t]he inclusion of data for one purpose and the exclusion of the same data for another, intimately related, purpose is impermissible" and "violates the best available science [\*\*176] standard." Doc. 551 at 27. *Sierra Club* does not stand for such a proposition. The *Sierra Club* plaintiffs challenged EPA's conclusion under the Clean Air Act that exceedences of air pollution standards on two particular days in Imperial County, California were caused by transborder emissions from Mexico. 346 F.3d at 959-60. The Ninth Circuit recognized that "where, as here, a court reviews an agency action involving primarily issues of fact," and where "analysis of the relevant documents requires a high level of technical expertise," we must "defer to the informed discretion of the responsible federal agencies." *Id.* at 961 (quoting *Marsh*, 490 U.S. at 377). Such deference was not owed where the agency decision "is without substantial basis in fact." *Id.* EPA's decision was vacated after plaintiffs presented uncontested evidence, based on wind data, that the pollution at issue was not caused by transborder emissions. *Id.* at 961-62. Nowhere did the Ninth Circuit discuss or find that EPA included data for one purpose while excluding it for some other related purpose, nor did it evaluate or even mention the ESA's best available science standard. Plaintiffs' argument is without legal or [\*\*177] factual support.

b. FWS's Use of Data to Examine the Relationship Between OMR Flows and Salvage and Exclusion of that Data from the Incidental Take Limit Analysis.

Plaintiffs next argue that FWS acted unlawfully by selectively using certain data when examining, the relationship between negative OMR flows and entrainment while excluding that same data from the calculation of the incidental take limit.

Where FWS concludes that "an action (or the implementation of any reasonable and prudent alternatives) and the resultant incidental take of listed species will not violate section 7(a)(2) ... the Service will provide with the biological opinion a statement concerning incidental take." 50 C.F.R. § 402.14(i)(1); *see also* 16 U.S.C. § 1536(b)(4); BiOp at 285-93. The Incidental Take Statement ("ITS") provides an exemption from the take prohibitions of ESA section 9 when the agency can demonstrate compliance with its terms and conditions. Consultation Handbook 4-47. It "specifies the impact, i.e., the amount or extent, of such incidental taking on the [\*\*926] species," with an estimate of the number of individuals

reasonably likely to be taken with full implementation of the RPA. <sup>35</sup> 50 C.F.R. § 402.14(i)(1)(i) [\*\*178] ; Consultation Handbook 4-50.

35 Federal Defendants note that there is no requirement that an ITS identify an anticipated number of listed species to be taken. *See Ariz. Cattle Growers*, 273 F.3d at 1249 ("We have never held that a numerical limit is required"); *Pacific Nw. Generating Coop. ("PNGC") v. Brown*, 822 F. Supp. 1479, 1510 (D. Or. 1993), *aff'd*, 38 F.3d 1058 (9th Cir. 1994). In rejecting such an argument in PNGC, the District of Oregon cited legislative history that "demonstrates that Congress fully anticipated that there would be occasions when impacts would have to be estimated." *Id.* (citing S. Rep. No. 97-418, 97th Cong.2d Sess. 21 (1982), U.S.C.C.A.N. 1982, p. 2807 (take specification not a "quota" requirement)). The court also noted that other legislative history stated, "The Committee ... does not intend that the Secretary will, in every instance, interpret the word 'impact' to be a precise number...For example, it may not be possible to determine the number of eggs of an endangered or threatened fish which will be sucked into a power plant ...." *Id.* (citing H.R. Rep. No. 97-567, 97th Cong., 2d Sess. 27 (1982), U.S.C.C.A.N. 1982, p. 2827)).

The Consultation Handbook enumerates [\*\*179] three criteria for ITS take: (1) the take must not be likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat; (2) it must result from an otherwise lawful activity; and (3) it must be incidental to the purpose of the action. Consultation Handbook 4-48. An agency action can meet the first criterion if the RPA eliminates the likelihood of jeopardy to the species or adverse modification of designated critical habitat. *Id.* If FWS determines that full implementation of the RPA is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat, the ITS is its estimate of the number of individuals which will be taken once the RPA is implemented. If this number is exceeded, the agency must immediately reinstate consultation with FWS. 50 C.F.R. § 402.14(i)(4).

FWS provided an ITS in the BiOp that sets forth the anticipated level of take that will occur as a result of CVP/SWP operations under the RPA. The BiOp employs an adaptive approach that utilizes a formula to compute the take limit each year using the prior Fall Midwater Trawl Index. BiOp at 287, 383-86. The ITS provides separate [\*\*180] estimates of the amount of take anticipated for adult and larval/juvenile life stages of delta smelt upon full implementation of the RPA. *Id.*

BiOp Appendix C explains the methods FWS used to determine adult and juvenile take. To estimate the amount of take, FWS approximated salvage that would be expected under similar conditions, based upon recent historic data from the export salvage facilities. <sup>36</sup> Goude Decl., Doc. 470, at ¶ 14. As Ms. Goude explains, the procedure FWS used yields a discrete value for take as salvage so that the adaptive process can operate relative to an estimate of the absolute number of fish extant in the system. *Id.* at ¶ 15. The calculation of incidental take varies by year under this [\*\*927] methodology, depending on the previous year's FMWT index. This allows take to increase as delta smelt abundance increases. *Id.* Conversely, when the FMWT index is low, the permissible level of take is also reduced. *Id.*

36 Ms. Goude explains in her declaration that the actual number of fish "salvaged" -- that is, recovered and counted at the export facility fish screens -- is a small proportion of those actually lost due to CVP/SWP operations. Goude Decl., Doc. 470, at ¶ 16. Pre-screen [\*\*181] losses (e.g., those that occur as they enter the structures of the export salvage facilities) can account for additional sources of mortality that remain uncounted, but have been shown to be significant for delta smelt and salmonids. *See* BiOp at 209. Also, delta smelt smaller than 20mm long are not counted in salvage counts, thus significant, uncounted losses of juveniles can occur. Goude Decl., Doc. 470, at ¶ 16. For these reasons, salvage is not a completely accurate measure of actual project take via entrainment. *Id.*

The BiOp sets an incidental take limit for pre-spawning adult delta smelt based on "[t]he average [cumulative salvage index] value for [water years] 2006 to 2008...." BiOp at 287. According to FWS, the years 2006, 2007 and 2008 data were selected because "these years within the historic dataset best approximate expected salvage under RPA Component 1." *Id.* In contrast, FWS relied on a graph that excluded data from 2007 when it analyzed the related "OMR-Salvage relationship for adult delta smelt" which underlies RPA Component 1 and the Project Effects Analysis. BiOp at 348. Plaintiffs argue that "the 2007 data should have been included in the above-described analyses or [\*\*182] excluded from both." Doc. 551 at 27. Plaintiffs point out that the inclusion of the 2007 data in calculating the incidental take limit lowered the average cumulative salvage index value and, the take limit ultimately imposed. *See* Deriso Decl., Doc. 396, at I 99 (explaining that exclusion of the 2007 data increased the take coefficient from 7.25 to 10.45). Plaintiffs maintain that FWS unjustifiably included 2005 data in setting the juvenile take limit, but excluded the data in setting the adult take limit.

The BiOp explains why these years were used. In estimating conditions under which take would occur, FWS initially restricted itself to those years where active adaptive management was used to reduce entrainment and salvage was similar to that expected by RPA operations. *See* BiOp 385-86. Only two years are comparable to this scenario, 2007 and 2008. In order to increase sample size for what FWS knew was a rough estimate, the BiOp utilized the range 2006 to 2008 for adult smelt entrainment, and 2005-2008 for juvenile smelt entrainment. Goude Decl., Doc. 470, at ¶ 14; *see* BiOp at 382-96.

Plaintiffs rejoin that "[i]t was per se unreasonable for FWS to make use of the 2007 salvage data in [\*\*183] calculating the ITS because it "best approximate[d] expected salvage under RPA Component 1," after earlier rejecting the same data for Fig. B-13 because it was unrepresentative of salvage trends, and thus could not be used to calculate the OMR flow limits for RPA Component 1." Doc. 697 at 43.

However, such data was used for an entirely different purpose in these two scenarios. Figure B-13 was applied to examine the point at which negative OMR flows posed an unacceptable danger to the smelt. It was premised on a data set of more than 20 years. It was reasonable under those circumstances to exclude data that accounted for confounding factors, such as turbidity. FWS determined that the best way to calculate the ITS (which seeks to estimate take levels that will occur if the RPA Actions are implemented) was to look at years in which flow restrictions similar to those imposed by the RPA Actions were in place. This data set was far smaller, arguably justifying the inclusion of 2007.

Plaintiffs' argument that 2007 should have been treated as an "outlier" for purposes of the ITS is not accurate. As Federal Defendants explain:

[D]ata from 2007 [] is, in actuality, data from conditions similar [\*\*184] to those under the RPA -- where there was salvage under adaptive management to reduce entrainment. Goude Decl. at ¶ 14. The estimates contained in the ITS are intended to reflect operations during a full [\*928] range of year-types, not just those years when smelt entrainment is highest.

Doc. 660 at 53-54.

Plaintiffs' assertion that the sample size of years was too small presents a scientific dispute. In preparing the ITS, FWS selected years for inclusion to replicate expected operations under the RPA. BiOp at 287. Due to limited data, FWS exercised scientific discretion to select

the "most appropriate" years to estimate the level of incidental take.

As to the inclusion of 2005 in the calculation for the juvenile take limit, but not in the adult take limit, the BiOp states:

The mean values from 2005-2008 were used as an estimate of take under the RPA. The reason for selecting this span of years is that the apparent abundance of delta smelt since 2005 as indexed by the 20-mm Survey and the TNS is the lowest on record. It was necessary to separate out this abundance variable, but also to account for other poorly understood factors relating salvage to OMR, distribution, and the extant conditions....

BiOp at 289. [\*\*185] Federal Defendants also attempt to provide an explanation based on the record:

[T]he Service explained the separate treatment of juveniles and adults, noting that "individuals of the larval/juvenile lifestage are less demographically significant than adults." BiOp at 289. Plaintiffs acknowledge - but dismiss - the biological justification that the Service provided for considering 2005 for juveniles: "the apparent abundance of delta smelt since 2005 ... is the lowest on record." BiOp at 289. Based on information from the summer townet survey and the 20mm Survey, it was reasonable for the Service to include the 2005 juvenile data in its computations. BiOp at 392.

Doc. 660 at 53. These justifications do not explain why the approach used to select the years for the adult ITS (years in which conditions mimicked those under the RPA) was abandoned for criteria based upon low smelt abundance. FWS has not provided a rational explanation for this aspect of the ITS.

Plaintiffs argue the 2006 data point should be excluded from the ITS calculation for larval/juvenile smelt, because that year was "one of only three years in the entire multi-decade sample in which OMR flow was positive, resulting in [\*\*186] almost zero salvage. *See* BiOp at 254." Doc. 551 at 32 (noting that the juvenile salvage index was 0.4 in 2006, compared with values of 23.4 for 2005, 65.1 for 2007, and 60.9 for 2008). Plain-

tiffs argue that the use of the 2006 data point to calculate the larval/juvenile ITS was unreasonable because it was entirely unrepresentative of normal salvage levels. Plaintiffs also point out that removing unrepresentative data points "significantly increases the take level." Deriso Decl., Doc. 396, at I 105. Federal Defendants do not address this potential flaw in the logic underlying the juvenile/larval ITS. Because the juvenile/larval ITS must be remanded on other grounds, FWS should explain why 2006 was included.

#### c. DWR's Additional Challenges the ITS.

DWR contends the ITS is flawed because it depends on the average cumulative salvage index of the years selected. Because the incidental take estimate is based on an average, there is theoretically a 50% chance each year that the estimate will be exceeded, and a corresponding 50% chance that the agency will have to reinitiate the consultation. Doc. 548 at 11-12. The estimate would have been exceeded in two of the three years used to calculate [\*\*187] it.

[\*929] The record does not explain why an "averaging" approach was used. As part of the process of formulating the ITS, FWS generated a "Concern Level" estimate, "meant to indicate salvage levels approaching the take threshold." BiOp at 387. FWS expressed its "belief" that the "Concern Level" should "trigger at 75 percent of the adult incidental take, as an indicator that operations need to be more constrained to avoid exceeding the incidental take." *Id.* This means the ITS is not only a threshold used to trigger reconsultation; it also functions as an action that influences operations under the RPA.

Based on known adverse water supply consequences of operating the Projects in a "constrained" manner, it is inexplicable that FWS did not provide a clear and rational explanation of how the ITS is set. A court, "cannot infer an agency's reasoning from mere silence," and "an agency's action must be upheld, if at all, on the basis articulated by the agency." *See PCFFA, 426 F.3d at 1091*. Because no such explanation or basis is provided, the entire ITS must be remanded for the required justifying explanation.

DWR further maintains that the BiOp incorrectly calculated the number of years in which [\*\*188] the incidental take limit was historically violated. The BiOp states that the take estimate would be exceeded only five out of the fifteen years between 1993 and 2008. BiOp at 386. This conclusion results from an error. BiOp Table C-1, calculating the number of years the take estimate was exceeded, actually shows that this threshold would be exceeded not only in the five identified years, but in six more years, including two of the years (2006 and 2008) that FWS believes best approximate the future

with the RPA fully implemented, a total of eleven out of the sixteen years. *Id.* FWS must correct these errors on remand.

#### (6) Challenges to the BiOp's Analysis of the Hydrodynamic Effects of the Projects.

Plaintiffs next challenge the BiOp's Project Effects Analysis as unlawful, because it: (1) bases the analysis of effects of Project Operations on the improper assumption that such operations "control" or "drive" hydrodynamic conditions in the Delta, and (2) then determines, relying on this assumption, that because CVP and SWP operations drive the hydrodynamic conditions in the Delta, those operations are the indirect cause of harm to delta smelt; when in truth a multitude of other causes ranging [\*\*189] from predation to the adverse effects associated with invasive species contribute to the delta smelt's currently low population levels.

The BiOp explains:

[There are a] multitude of factors that affect delta smelt population dynamics including predation, contaminants, introduced species, entrainment, habitat suitability, food supply, aquatic macrophytes, and microcystis. The extent to which these factors adversely affect delta smelt is related to hydrodynamic conditions in the Delta, which in turn are controlled to a large extent by CVP and SWP operations. . . . So while many of the other stressors that have been identified as adversely affecting delta smelt were not caused by CVP and SWP operations, the likelihood and extent to which they adversely affect delta smelt is highly influenced by how the CVP/SWP are operated in the context of annual and seasonal hydrologic conditions. While research indicates that there is no single primary driver of delta smelt population dynamics, hydrodynamic conditions driven or influenced by CVP/SWP operations in turn influence the dynamics of [\*930] delta smelt interaction with these other stressors (Bennett and Moyle 1996).

BiOp at 202. Plaintiffs take issue [\*\*190] with the logic and science of this opinion, asserting: (1) in reality, Project Operations do not "control" or "drive" hydrodynamic conditions in the Delta; and (2) hydrodynamic conditions in the Delta do not exert a "high degree of

influence" over the other stressors on delta smelt and its habitat, which operate independently.

a. Project Operations as a Driver of Hydrodynamic Conditions in the Delta.

Plaintiffs complain that the BiOp "simply assumed that Project Operations drive hydrodynamics thereby exacerbating the effects of other causes of harm on the delta smelt," although the contrary is established by the record. Doc. 551 at 53. Plaintiffs maintain that Project Operations do not control precipitation patterns, which are the real drivers of inflow to the Delta watershed. *Id.*<sup>37</sup>

37 In a related argument, Plaintiffs challenge the BiOp's conclusion that the long-term upstream shift in the position of X2 was driven by Project Operations. Plaintiffs insist that the premise that Project operations drive hydrodynamic conditions in the Delta is unsupported by the record and best available science. Rather, they insist historic change in X2 was primarily driven by non-Project causes. Doc. [\*191] 697 at 38. The majority of evidence provided by Plaintiffs in support of this argument, cited in their Reply brief, is inadmissible on summary judgment. For example, Plaintiff's cite paragraph 5 of the Reply Declaration of Dr. Charles Hanson, Doc. 598, which was stricken from the record, *see* Doc. 750 at ¶ 10. Plaintiffs also cite extensively to the transcript from the evidentiary hearing on the motion for preliminary injunction. Plaintiffs have provided no authority that the testimony of witnesses at a post-record hearing is admissible under any of the exceptions to the general rule prohibiting consideration of extra-record evidence, except to explain scientific matter and to determine if the information was considered by the agency.

CALFED scientists concluded in a 2008 Report:

Despite California's extensive system of water storage and flow management, there is growing evidence that our capacity to manage water supply and water quality is limited. For example, there is no getting around the fact that natural patterns of precipitation and runoff drive Central Valley hydrology, and that the salinities found in the Bay-Delta are driven as much by natural climate variability as they are [\*192] by freshwater management (Knowles 2002).

CALFED Science Program, The State of Bay-Delta Science 2008 42-43 (2008), Doc. 199 ("State of Bay-Delta Science").<sup>38</sup> Similarly, Dr. Kimmerer has stated:

Freshwater supply to the San Francisco Estuary depends on highly variable precipitation patterns and the effects of extensive water development projects upstream and within the Delta....

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Given the extent and magnitude of the water projects, it may seem paradoxical that most of the interannual variability in flow patterns in the estuary is due to variability in precipitation.

Wim J. Kimmerer, Open Water Processes of the San Francisco Estuary: From Physical Forcing to Biological Responses, 2(1) San Francisco Estuary & Watershed Science 15 (2004), AR 18717-18718. Indeed, precipitation patterns are highly variable. *See* State of Bay-Delta Science at 40-42 ("precipitation patterns are highly [\*931] variable from year to year (inter-annually) and within years (seasonally)"). As a result, "[f]reshwater input to the estuary is highly variable on all time scales." Wim J. Kimmerer et al., Variation of Physical Habitat for Estuarine Nekton with Freshwater Flow in the San Francisco Estuary (May 15, 2008), AR 019016; [\*193] *see also* Public Policy Institute of California, Envisioning Futures for the Sacramento-San Joaquin Delta 102 (2007) (stating that inflows to the Delta "vary greatly across seasons and years"), AR 019343.

38 Plaintiffs motion to supplement the record with this document was granted in part, allowing Plaintiffs to reference the document and the Court to consider the document under the relevant factors exception to the administrative record doctrine. Doc. 406 at 4.

The first paragraph of the Effects analysis states that "hydrodynamic conditions in the Delta... are controlled to a large extent by CVP and SWP [pumping] operations," and that other sources of water diversion "when taken together do not control hydrodynamic conditions throughout the Delta to any degree that approaches the influence of the Banks and Jones export facilities." BiOp at 202. This apparent inconsistency with the science must be considered in light of the BiOp's next page, which explains that "every day the system is in balanced conditions, the CVP and SWP are [] primary driver[s] of delta smelt abiotic and biotic habitat suitability, health, and mortality." BiOp at 203. The BiOp does not assume that

pumping operations [\*\*194] continuously drive hydrodynamic conditions; rather, Project operations primarily drive hydrodynamic conditions when the system is in balance.<sup>39</sup> With this qualification, the studies cited by Plaintiffs do not conflict with the BiOp.

39 The BiOp explains: "Balanced water conditions are defined in the COA as periods when it is mutually agreed that releases from upstream reservoirs plus unregulated flows approximately equal[] the water supply needed to meet Sacramento Valley in-basin uses plus exports. Excess water conditions are periods when it is mutually agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses plus exports. Reclamation's Central Valley Operations Office (CVOO) and DWR's SWP Operations Control Office jointly decide when balanced or excess water conditions exist." BiOp at 19.

"The duration of balanced water conditions varies from year to year. Some very wet years have had no periods of balanced conditions, while very dry years may have had long continuous periods of balanced conditions, and still other years may have had several periods of balanced conditions interspersed with excess water conditions. Account balances continue [\*\*195] from one balanced water condition through the excess water condition and into the next balanced water condition. When the project that is owed water enters into flood control operations, at Shasta or Oroville, the accounting is zeroed out for that respective project. The biological assessment provides a detailed description of the changes in the COA." BiOp at 20-21.

The scientific literature does a side-by-side analysis. Kimmerer (2004) finds that "most of the interannual variability in flow patterns in the estuary is due to variability in precipitation ... due to the overwhelming effect of high flow events." AR 18718. He describes the following impacts of the CVP-SWP:

The water projects have clearly affected the seasonal patterns of flow into the estuary (Kimmerer 2002b). Springtime flow has decreased significantly relative to unimpaired flow because of shifts in water project operations each year from flood management in winter, during which reservoirs are kept at relatively low levels, to water storage in spring, when much of the flow is captured for subsequent irrigation. In addition, flow in summer and early fall

is higher than unimpaired flow to support demand for irrigation and [\*\*196] urban use, much of which is met by releases from reservoirs into the rivers and subsequent recapture and export from the Delta (Arthur et al. 1996).

[\*932] *Id.* While the CALFED report observes that "natural patterns of precipitation and runoff drive Central Valley hydrology," it also finds that "[r]ecent examination of the impacts of water project development in the state has documented species population losses due to destruction of habitat, alteration of flow timing and changes in water chemistry, water velocities and runoff quantities." Doc. 199-4 at 15.

The BiOp recognizes that "delta smelt abundance trends have been driven by multiple factors, some of which are affected or controlled by CVP/SWP operations and others that are not. Notably, the BiOp acknowledges the decline of delta smelt cannot be explained solely by the effects of CVP/SWP operations." BiOp at 203. The BiOp's conclusions about the cause and effect of other stressors are ambiguous. Plaintiffs' quest for precision in delinking Project operations as the primary driver of smelt decline is understandable in view of the ambiguity of the BiOp.

#### b. Treatment of Other Stressors.

Plaintiffs complain that the BiOp attributes a wide variety [\*\*197] of causes of harm to delta smelt and its habitat--such as aquatic macrophytes, predators, competition, toxic blue-green algae, and contaminants--to continued Project Operations, without any meaningful explanation. *See* BiOp at 182-188, 202-203.

The BiOp concludes:

Other baseline stressors will continue to adversely affect the delta smelt, such as contaminants, microcystis, aquatic macrophytes, and invasive species. Available information is inconclusive regarding the extent, magnitude and pathways by which delta smelt may be affected by these stressors independent of CVP/SWP operations. However, the operation of the CVP/SWP, as proposed, is likely to reduce or preclude seasonal flushing flows, substantially reduce the natural frequency of upstream and downstream movement of the LSZ, and lengthen upstream shifts of the LSZ to an extent that may increase the magnitude and frequency of adverse

effects to the delta smelt from these stressors.

BiOp at 277.

[\*933] Plaintiffs argue that the BiOp makes no rational connection between the other causes of harm to the smelt and their habitat and continued Project Operations.<sup>40</sup> Plaintiffs acknowledge that the BiOp contains some discussion of various causes of [\*198] harm to delta smelt and their habitat other than from Project Operations, BiOp at 182-188, but complain that the BiOp "does not quantitatively (or even qualitatively) explain the [independent] impact that these causes of harm to the species and its habitat have on the size of the delta smelt population, nor to the ostensible ecological pathways by which these environmental stressors affect the fish." Doc. 551 at 56-57.

40 Specifically, Plaintiffs maintain that, to comply with the law, FWS must "(1) analyze the effect that other causes of harm have on the delta smelt and its habitat; (2) analyze the extent to which hydrodynamics contribute to each of those other causes of harm to the species and its habitat; (3) analyze the extent to which Project Operations--as distinguished from the other operations that result in the diversion of most of the water from the Delta's watershed--influence hydrody-

namics in the Delta watershed; and (4) assess the extent of harm attributable to other causes that can be traced to Project Operations in light of such an analysis." Doc. 551 at 56. Plaintiffs point to no statute, regulation, or caselaw that imposes such specific requirements. Nonetheless, the BiOp [\*199] must establish a rational connection between the facts and its conclusion that Project Operations exacerbate the impacts of other stressors.

Plaintiffs argue that the BiOp's treatment of other stressors conflicts with a "consensus that has emerged over the last several years in the scientific community that there are a host of causes of harm to the species that collectively have contributed to its decline." *Id.* at 57. Plaintiffs point to a 2007 Public Policy Institute of California Report entitled "Envisioning Futures for the Sacramento-San Joaquin Delta" by Jay Lund, et al., which discusses how "[s]everal basic assumptions on how the [Sacramento-San Joaquin] estuary operates have proven to be incorrect or only partially correct." AR 19303. The PPIC report describes these revised understandings as a set of "paradigm shifts" in Table 4.1, reproduced in substance below:

**Table 4.1**

**New Understanding of the Delta Ecosystem**

<b>New Paradigm</b>	<b>Old Paradigm</b>
<b>1. Uniqueness of the San Francisco Estuary</b>	
The San Francisco Estuary has complex tidal hydrodynamics and hydrology. Daily tidal mixing has more influence on the ecology of the estuary than riverine outflows, especially in the western and central Delta. Conditions that benefit striped bass (an East Coast species) do not necessarily benefit native organisms.	The San Francisco Estuary works on the predictable model of East Coast estuaries with gradients of temperature and salinity controlled by outflow. Freshwater outflow is the most important hydrodynamic force, If the estuary is managed for striped bass, all other organisms, and especially other fish, will benefit.
<b>2. Invasive Species</b>	
Alien species are a major and growing problem that significantly inhibits our ability to manage in support of desirable species.	Alien (normative) species are a minor problem or provide more benefits than problems,
<b>3. Interdependence</b>	
Changes in management of one part of the system affect other parts. All are part of the estuary and can change states in response to outflow and climatic	The major parts of San Francisco Estuary can be managed independently of one another. The Delta is a freshwater system, Suisun Bay and Marsh are a brackish water

<b>New Paradigm</b>	<b>Old Paradigm</b>
conditions. Floodplains are of major ecological importance and affect estuarine function. Suisun Marsh is an integral part of the estuary ecosystem and its future is closely tied to that of the Delta.	system, and San Francisco Bay is a marine system. Floodplains such as the Yolo Bypass have little ecological importance, Suisun Marsh is independent of the rest of the estuary
<b>4. Stability</b>	
The Delta will undergo dramatic changes in the next 50 years as its levees fail because of natural and human-caused forces such as sea level rise, flooding, climate, and subsidence. A Delta ecosystem will still exist, with some changes benefiting native species. Agriculture is unsustainable in some parts of the Delta.	The Delta is a stable geographic entity in its present configuration. Levees can maintain the Delta as it is. Any change in the Delta will destroy its ecosystem, Agriculture is the best use for most Delta lands,
<b>5. Effects of Human Activities</b>	
Pumping in the Delta is an important source of fish mortality but only one of several causes of fish declines. Entrainment of fish at the power plants is potentially a major source of mortality. Changes in ocean conditions (El Nino events, Pacific Decadal Oscillation, ocean fishing, etc.) have major effects on the Delta. Hatcheries harm wild salmon and steelhead. Chronic toxicants continue to be a problem, and episodic toxic events from urban and agricultural applications are also a major problem.	Pumping in the southern Delta is the biggest cause of fish declines in the estuary. Fish entrainment at power plants is a minor problem. Changes in ocean conditions have no effect on the Delta. Hatcheries have a positive or no effect on wild populations of salmon and steelhead. Chronic toxicants (e.g., heavy metals, persistent pesticides) are the major problems with toxic compounds in the estuary,

AR [\*\*200] 19305-306. The fifth paradigm shift finds that Delta Pumping is an "important source of fish mortality but only one of several causes of fish declines." AR 019306. This finding is further supported by the Interagency Ecological Program's conceptual model that describes observed pelagic fish declines in the Delta and recognizes numerous sources of harm to the species including contaminants, disease, toxic algal blooms, climate change, predation, entrainment in diversions, and limited food availability, limited food co-occurrence with the species, and poor food quality. *See* Randall Baxter et al., Pelagic Organism Decline Progress Report: 2007 Synthesis [\*\*934] of Results (2008) AR 16935-53. In light of this general, undisputed consensus that many factors contribute to delta smelt mortality, Plaintiffs challenge the BiOp's attribution to the Projects of the effects of: (1) predation; (2) aquatic macrophytes; and (3) microcystis.

(1) Predation Analysis.

Plaintiffs describe the BiOp's predation as a purportedly flawed attribution of another stressor to Project Operations. The BiOp generally acknowledges that striped bass prey on the delta smelt but concludes that "[i]t is unknown whether incidental [\*\*201] predation by striped bass (and other lesser predators) represents a substantial source of mortality for delta smelt." BiOp at 183. The BiOp does not include any estimates of the effect of predation on the delta smelt population. Such information was available. The Conservation Plan for DFG's Striped Bass Management Program ("Conservation Plan"), which was submitted to FWS as part of an application for an incidental take permit, states: "[d]espite the low incidence of delta smelt in striped bass stomachs, the year-round overlap in distribution of delta smelt and striped bass results in an estimated annual consumption of about 5.3% of the delta smelt population by a striped bass population of approximately 765,000 adults." Doc. 181-1 at 32 (emphasis added). The Conservation Plan explains that FWS and DFG "have agreed that a predation rate of 5.3% of the annual delta smelt population is a reasonable estimate." *Id.* at 33. FWS issued an incidental

take permit to DFG on the basis of this striped bass predation estimate. There is question whether this underestimates the effect on delta smelt of bass predation. See First Amended Complaint, *Coalition v. McCamman*, 1:08-cv-00397 OWW GSA, Doc. [\*\*202] 46.

FWS need not include every piece of available information regarding other stressors in the BiOp. *Kempthorne*, 506 F. Supp. 2d at 367 ("If FWS was required to consider and address every new piece of information it received prior to publication of its decision, it would be effectively impossible for the agency to complete a biological opinion."). However, FWS cannot ignore relevant information pertaining to a major source of mortality to the species, particularly when that information is decidedly contrary to BiOp findings. It is not clear from the record whether 5.6% mortality should be considered significant. In related contexts, mortality of 1% has been used as an incidental take limit, see Findings of Fact and Conclusions of Law Re Existence of Irreparable Harm, *PCFFA v. Gutierrez*, 1:06-cv-00245 OWW GSA, Doc. 367 at 48:5-9 (noting that incidental take limit for winter-run Chinook salmon is set at two percent of the estimated number of juveniles produced each year), suggesting that such small percentages may be significant enough to merit discussion. The 5.3% figure may be partially attributable to Project operations. As the BiOp explains, there are high rates of predation in Clifton [\*\*203] Court Forebay, BiOp 160-161, 209, but the contribution of striped bass predation to this mortality is not articulated. The BiOp erroneously failed to consider available information regarding the magnitude of striped bass predation on delta smelt, with the likely result of erroneously attributing to the Projects, impacts independent of Project Operations.

## (2) Aquatic Macrophytes.

The BiOp discusses aquatic macrophytes:

In the last two decades, the interior Delta has been extensively colonized by submerged aquatic vegetation. The dominant submerged aquatic vegetation is *Egeria densa*, a nonnative from South [\*\*935] America that thrives under warm water conditions. Research suggests that *Egeria densa* has altered fish community dynamics in the Delta, including increasing habitat for centrarchid fishes including largemouth bass (Nobriga et al. 2005; Brown and Michniuk 2007), reducing habitat for native fishes (Brown 2003; Nobriga et al. 2005; Brown and Michniuk 2007), and supporting a food web pathway for centrarchids and other littoral

fishes (Grimaldo et al in review). *Egeria densa* has increased its surface area coverage by up to 10 percent per year depending on hydrologic conditions and water temperature [\*\*204] (Erin Hestir personal communication University of California Davis).

*Egeria densa* and other non-native submerged aquatic vegetation (e.g., *Myriophyllum spicatum*) can affect delta smelt in direct and indirect ways. Directly, submerged aquatic vegetation can overwhelm littoral habitats (inter-tidal shoals and beaches) where delta smelt may spawn making them unsuitable for spawning. Indirectly, submerged aquatic vegetation decreases turbidity (by trapping suspended sediment) which has contributed to a decrease in both juvenile and adult smelt habitat. Increased water transparency may delay feeding and may also make delta smelt more susceptible to predation pressure.

BiOp at 182-183. General discussions of *Egeria densa* are included in the Critical Habitat section of the BiOp. BiOp at 196, 198, 201. Discussion of PCE # 2 explains:

As stated in the Status and Baseline Section, research suggests that the nonnative South American aquatic plant *Egeria densa* has altered fish community dynamics in the Delta. In addition to the above-mentioned effect of overwhelming spawning habitat (PCE #1), *Egeria* and other submerged aquatic vegetation decreases turbidity by trapping suspended sediment, thereby [\*\*205] decreasing juvenile and adult smelt habitat (Feyrer et al. 2007; Nobriga et al. 2008). Increased water transparency may also make delta smelt more susceptible to predation. It appears that aquatic macrophytes may have a role in degrading pelagic habitat to the extent that the Delta's ability to fulfill its intended conservation purpose continues to diminish. *Egeria* has the additional effect of decreasing turbidity, described above as important to successful feeding of newly-hatched larval delta smelt. However, there is still enough turbidity in the Central and South Delta to initiate larval

feeding responses because larvae collected in the South Delta have comparatively high growth rates. So while *Egeria* may reduce or eliminate the extent and quality of spawning habitat for delta smelt, it is not at this considered to have detectable effects on spawning or early feeding success.

BiOp at 198.

The BiOp concludes:

Available information is inconclusive regarding the extent, magnitude and pathways by which delta smelt may be affected by these stressors independent of CVP/SWP operations. However, the operation of the CVP/SWP, as proposed, is likely to reduce or preclude seasonal flushing flows, [\*\*206] substantially reduce the natural frequency of upstream and downstream movement of the LSZ, and lengthen upstream shifts of the LSZ to an extent that may increase the magnitude and frequency of adverse effects to the delta smelt from these stressors.

BiOp at 277. Although a connection may exist, the record does not reflect any discussion, nor have the parties pointed to any study, connecting "seasonal flushing flows ... [\*\*936] the natural frequency of upstream and downstream movement of the LSZ, and lengthen[ed] upstream shifts of the LSZ" to the presence of any aquatic macrophyte. FWS has failed to make a rational connection between the facts in the record and its conclusions, particularly when the science indicates the contrary is likely true.

### (3) Microcystis

FWS makes no connection whatsoever between microcystis, large blooms of toxic blue-green algae, and continued CVP and SWP operations. *See* BiOp at 186. In a discussion regarding the Vernalis Adaptive Management Plan (VAMP) period, <sup>41</sup> FWS stated:

Without the flow component, the larval and juvenile delta smelt would remain in the Central and South Delta, where they could be exposed to lethal water temperatures, entrainment at Banks and Jones [\*\*207] after the VAMP export curtail-

ment period, or succumb to predation or microcystis blooms.

BiOp at 224. The BiOp does not analyze the effect that this asserted increased exposure to other stressors has on the delta smelt, or how it is caused by Project Operations; rather, FWS simply concludes without support that this effect buttresses a determination that the proposed action will jeopardize the delta smelt.

41 "Adopted by the SWRCB in D-1641, the San Joaquin River Agreement (SJRA) includes a 12-year program providing for flows and exports in the lower San Joaquin River during a 31-day pulse flow period during April and May. It also provides for the collection of experimental data during that time to further the understanding of the effects of flows, exports, and the barrier at the head of Old River on salmon survival. This experimental program is commonly referred to as the VAMP (Vernalis Adaptive Management Plan)." BiOp at 78.

It is undisputed that numerous stressors, including ammonia and other toxics, food limitation, predation, the introduction of non-native species and other factors, all have adverse impacts to delta smelt. *See e.g.*, BiOp at 182-84 (discussing other stressors). Yet, [\*\*208] the BiOp concludes that Project Operations are "a primary factor influencing delta smelt abiotic and biotic habitat suitability, health, and mortality." BiOp at 189 (emphasis added). FWS rationalizes this conclusion, at least in part, by attributing the impacts of many of the "other stressors" to the Projects. This attribution has not been justified, nor is it logical or explained by any science. Given that the impacts of regulating Project Operations are so consequential, such unsupported attributions (a result in search of a rationale) are unconscionable.

### (7) Indirect Effects Analysis.

Plaintiffs assert that the BiOp inappropriately categorizes adverse effects on delta smelt from limited food supply, invasive species, and contaminants as "indirect effects" caused by Project Operations. The Joint Consultation Regulations promulgated by FWS and NMFS define: "[i]ndirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." 50 C.F.R. § 402.02 (emphasis added). The ESA's definition differs from NEPA's definition of indirect effects of an action: "[i]ndirect effects, which are caused by the action and are later in time [\*\*209] or farther removed in distance, but are still reasonably foreseeable." 40 C.F.R. § 1508.8(b). In the preamble of the Final Rule adopting the ESA regulations,

FWS explained that it intended a narrower regulatory definition of indirect effects under the ESA than applied in the NEPA context (i.e., compare "reasonably [\*937] certain to occur" with "reasonably foreseeable"). *51 Fed. Reg. 19, 926 (June 3, 1986)*. NMFS and FWS contrasted the ESA with NEPA and expressly explained the intent and rationale for adopting the more narrow "reasonably certain to occur" standard for indirect and cumulative effects under ESA:

If the jeopardy standard is exceeded, the proposed Federal action cannot proceed without an exemption. This is a substantive prohibition that applies to the Federal action involved in consultation. In contrast, NEPA is procedural in nature, rather than substantive, which would warrant a more expanded review of cumulative effects. Otherwise, in a particular situation, the jeopardy prohibition could operate to block "nonjeopardy" actions because future, speculative effects occurring after the Federal action is over might, on a cumulative basis, jeopardize a listed species. Congress did not [\*\*210] intend that Federal actions be precluded by such speculative actions.

*51 Fed. Reg. at 19, 933.*

Shortly after adoption of the ESA regulations, the Ninth Circuit confirmed "[t]he reasonably certain to occur" standard applies to 'indirect effects ... caused by the proposed action.' *Sierra Club v. Marsh*, 816 F.2d 1376, 1388 (9th Cir. 1987) ; see also *Ariz. Cattle Growers Ass'n v. FWS*, 273 F.3d 1229, 1243 (9th Cir. 2001) (invalidating several incidental take statements regarding grazing and effects on fish because "it would be unreasonable for [FWS] ... to impose conditions on otherwise lawful land use if a take were not reasonably certain to occur as a result of that activity"); *Ctr. for Biological Diversity v. U.S. Dept. of Hous. & Urban Dev.*, 541 F. Supp. 2d 1091, 1100-01 (D. Ariz. 2008) (dismissing a suit alleging federal agencies had violated the ESA by failing to analyze the indirect effects of providing federal funding to local development projects, concluding that the link between such financial assistance and groundwater depletion that could harm listed species was "too attenuated" to meet the standards of 50 C.F.R. § 402.02). "[T]he mere potential for harm ... is insufficient" [\*\*211] to meet the "reasonably certain to occur" standard. *Ariz. Cattle Growers Ass'n*, 273 F.3d at 1246. Other causes must be addressed applying this standard.

a. Effect of Project Operations on Delta Smelt Food Supplies.

The BiOp claims that one of "three major seasonally occurring categories of effects" on delta smelt is "entrainment of *Pseudodiaptomus forbesi*"<sup>42</sup>, the primary prey of delta smelt during summer-fall." BiOp at 203. The BiOp categorizes this as an "indirect effect." *id.*, and justifies RPA Component 4 (Action 6)<sup>43</sup> in part by the statement that "[t]he Effects Section indicates that [*P. forbesi*] distribution may be vulnerable to effects of export facilities operations and, therefore, the projects have a likely effect on the food supply available to delta smelt." BiOp at 380-81.

42 *Pseudodiaptomus forbesi* is a small aquatic copepod introduced into the Delta in 1988, and has since become an important source of prey for delta smelt. BiOp at 184.

43 Action 6 requires the creation or restoration of 8,000 acres (12.5 square miles) of habitat. BiOp at 379.

The relevant section of the effects analysis provides:

Entrainment of *Pseudodiaptomus forbesi* (June-September) Historically, the diet of [\*\*212] juvenile delta smelt during summer was dominated by the copepod *Eurytemora affinis* and the mysid shrimp *Neomysis mercedis* (Moyle et al. 1992; Feyrer et al. 2003). These prey bloomed from within the [\*938] estuary's LSZ and were decimated by the overbite clam *Corbula amurensis* (Kimmerer and Orsi 1996), so delta smelt switched their diet to other prey. *Pseudodiaptomus forbesi* has been the dominant summertime prey for delta smelt since it was introduced into the estuary in 1988 (Lott 1998; Nobriga 2002; Hobbs et al. 2006). Unlike *Eurytemora* and *Neomysis*, *Pseudodiaptomus* blooms originate in the freshwater Delta (John Durand San Francisco State University, oral presentation at 2006 CALFED Science Conference). This freshwater reproductive strategy provides a refuge from overbite clam grazing, but *Pseudodiaptomus* has to be transported to the LSZ during summer to co-occur with most of the delta smelt population. This might make *Pseudodiaptomus* more vulnerable to pumping effects from the export facilities than *Eurytemora* and *Neomysis* were. By extension, the projects

might have more effect on the food supply available to delta smelt than they did before the overbite clam changed the LSZ food web. As [\*\*213] evidence for this hypothesis, the IEP Environmental Monitoring Program zooplankton data show the summertime density of *Pseudodiaptomus* is generally higher in the South Delta than in Suisun Bay. The ratio of South Delta *Pseudodiaptomus* density to Suisun Bay *Pseudodiaptomus* density was greater than one in 73 percent of the collections from June- September 1988-2006. The average value of this ratio is 22, meaning that on average summer *Pseudodiaptomus* density has been 22 times higher in the South Delta than Suisun Bay. Densities in the two regions are not correlated ( $P > 0.30$ ). This demonstrates that the presence of high copepod densities in the South Delta which delta smelt do not occupy during summer months, do not necessarily occur simultaneously in the LSZ where delta smelt rear.

There is statistical evidence suggesting that the cooccurrence of delta smelt and *Pseudodiaptomus forbesi* has a strong statistical influence on the survival of young delta smelt from summer to fall (Miller 2007). In addition, recent histopathological evaluations of delta smelt have shown possible evidence of food limitation in delta smelt during the summer (Bennett 2005; Bennett et al. 2008). However, the [\*\*214] glycogen depletion of the delta smelt livers reported in these studies can also arise from thermal stress due to high summer water temperatures (Bennett et al. 2008).

BiOp at 228. These observations show that *P. forbesi* from the southern Delta are an important source of summer food supply to delta smelt in the lower salinity zone ("LSZ"), and that Project Operations (i.e., export pumping) prevent *P. forbesi* in the South Delta from flowing to the LSZ during that time, causing a reduction in the density of *P. forbesi* that subsequently causes deleterious effects to delta smelt.

Federal Defendants are correct that nothing in the ESA requires FWS to rule out all other potential factors that may or may not play a role in the ecosystem under analysis. See Doc. 660 at 58. However, the ESA does require the agency to evaluate the impacts of the pro-

posed action, and make a determination whether the proposed action is likely to have direct and indirect effects on the species. 50 C.F.R. § 402.02 (defining "jeopardize the continued existence of" to mean "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and [\*\*215] recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species."). Plaintiffs argument is simply that "there was no [\*\*939] data or analysis in the BiOp (or elsewhere in the record) to support the BiOp's finding that export pumping causes reduced availability of [*P. forbesi*] for consumption by delta smelt in the Low Salinity Zone and that this reduced availability is reasonably certain to occur." Doc. 695 at 55.

Plaintiffs' central complaint is that in evaluating the indirect effect of Project operations on *P. forbesi*, FWS used data from a few Suisun Bay sampling stations to represent the entire lower salinity zone, even though the low salinity zone occurs outside Suisun Bay as well. <sup>44</sup> The peer review found a "relationship between outflow and abundance of *P. forbesi* in the [lower salinity zone] ... can be detected only by comparing the distribution of copepods in salinity space rather than relying on sampling station locations." AR 008821. FWS did nothing to correct this problem in the final Effects Analysis.

44 Plaintiffs also summarily argue that this conclusion is unjustified because:

o FWS did not consider or rule out the fact that grazing [\*\*216] by exotic clam species causes the observed reduced *P. forbesi* density in Suisun Bay.

o FWS did not consider or rule out the fact that higher densities of *P. forbesi* in the South Delta are caused by differences in spatial distribution between juvenile and adult *P. forbesi* because juveniles are more dense in the South Delta.

o FWS did not consider or account for the fact that Plaintiffs provided FWS with results of regression analyses of the best scientific data available that showed "[*P. forbesi*] densities in Suisun Bay are not correlated with exports ...," but that there is "a highly significant correlation between [*P. forbesi*] densities in Suisun Bay and those in Suisun Marsh, suggesting (unsurprisingly) that if Suisun Bay densities are being subsidized, the most likely source is Suisun Marsh." AR 006369; 006377-006378.

Doc. 551 at 48-49. The support for these arguments were incorporated by reference from the extensive argument concerning the BiOp's food

analysis contained in Plaintiffs' motion for Preliminary Injunction. Given the prolixity of briefing and the highly contentious process by which page limits for the motions for summary judgment were set in this case, it would be highly [\*\*217] prejudicial to Defendants to permit such extensive incorporation by reference into the summary judgment proceedings. These arguments will not be addressed.

Plaintiffs also complain that the BiOp contains no quantitative analysis of the impact of exports on *P. forbesi*. Federal Defendants' only response to this criticism is to point out that the draft BiOp did contain a quantitative analysis. This draft was presented to the Peer Review panel, which responded that it "agree[d] with the conceptual model and with the justification of its elements" as "well-supported," but had concerns about parts of that analysis, and recommended that it be revised. Goude Decl., Doc. 470, ¶ 5. The Panel concluded that if a "revised analysis does not show a substantial (not necessarily statistically significant) pattern, the analysis should be mentioned but the results dropped as a quantitative metric from the [Effects Analysis]." *Id.* After considering the Panel's recommendation, FWS decided not to use the analysis as a quantitative metric, instead concluding that a qualitative analysis and discussion was sufficient and appropriate for the final 2008 Biological Opinion. *Id.* The BiOp does contain a qualitative [\*\*218] discussion of the impacts of the Delta Food Web, acknowledging the effects that the overbite clam has had on the pelagic food web, including upon the delta smelt, BiOp at 184-85, but noting "it is uncertain whether this is a direct consequence of the overbite clam." BiOp at 184.

Although nothing in the ESA mandates the use of quantitative analyses *per se*, the Peer Review's critique of the *P. forbesi* analysis cannot be separated from FWS's abandonment of its quantitative analysis. [\*\*940] The Peer Review specifically criticized the use of fixed-location monitoring sites as part of the quantitative analysis. Rather than correct this problem, FWS's response was to abandon the quantitative analysis, choosing to advance the same, potentially flawed conclusion in a more subjective, qualitative analysis. This conduct suggests another unlawful, results-driven choice, ignoring best available science.

#### b. Pollution and Contaminants

The BiOp claims "[r]earing habitat in the South Delta may also be impacted indirectly through increases in contaminant concentrations." BiOp at 242. In assessing Project effects to critical habitat, the BiOp states "[t]he contaminant effects may be generated or diluted by flow [\*\*219] depending on the amount of flow, the

type of contaminant, the time of year, and relative concentrations." BiOp at 240.

Plaintiffs argue "[g]eneral statements like this do not comport with ESA's requirements for attributing indirect effects to an action." Doc. 661 at 50. Plaintiffs contend: "[t]o meet ESA's regulatory standard for indirect effects," requiring such indirect effects be "reasonably certain to occur" FWS must "support these general hypotheses with discussion and use of scientific data showing":

(1) how a specific individual contaminant concentration (e.g., ammonia, mercury, pyrethroids, etc.) would be increased by a particular flow modification caused by Project Operations;

(2) at what time of year or month such flow modifications and contaminant concentration increases would occur; and

(3) how and to what extent this alleged contaminant increase would affect the abundance of delta smelt.

*Id.* Plaintiffs do not cite any specific statute, regulation, or case that requires such specific findings before an impact is a sufficient indirect effect. The record must reflect that contaminant-related impacts indirectly caused by Project Operations are "reasonably certain" to occur. It [\*\*220] is undisputed that contaminants are not introduced by the Projects, rather by others conducting municipal, industrial, and agricultural (runoff) activities.

FWS provided a qualitative discussion of the impacts of pollutants and changed Delta hydrodynamics resulting from Project operations upon the smelt:

**Contaminants** Contaminants can change ecosystem functions and productivity through numerous pathways. However, contaminant loading and its ecosystem effects within the Delta are not well understood. Although a number of contaminant issues were first investigated during the POD years, concern over contaminants in the Delta is not new. There are long-standing concerns related to mercury and selenium levels in the watershed, Delta, and San Francisco Bay (Linville et al. 2002; Davis et al. 2003). Phytoplankton growth rate may, at times, be inhibited by high concentrations of herbicides (Edmunds et al. 1999). New evidence indicates that phytoplankton growth rate is

chronically inhibited by ammonium concentrations in and upstream of Suisun Bay (Wilkerson et al. 2006, Dugdale et al. 2007). Contaminant-related toxicity to invertebrates has been noted in water and sediments from the Delta and associated [\*\*221] watersheds (e.g., Kuivila and Foe 1995, Giddings 2000, Werner et al. 2000, Weston et al. 2004). Undiluted drainwater from agricultural drains in the San Joaquin River watershed can be acutely toxic (quickly lethal) to fish and have chronic effects on growth (Saiki et al. 1992). Evidence for mortality [\*941] of young striped bass due to discharge of agricultural drainage water containing rice herbicides into the Sacramento River (Bailey et al. 1994) led to new regulations for water discharges. Bioassays using caged Sacramento sucker (*Catostomus occidentalis*) have revealed deoxyribonucleic acid strand breakage associated with runoff events in the watershed and Delta (Whitehead et al. 2004). Kuivila and Moon (2004) found that peak densities of larval and juvenile delta smelt sometimes coincided in time and space with elevated concentrations of dissolved pesticides in the spring. These periods of cooccurrence lasted for up to 2-3 weeks, but concentrations of individual pesticides were low and much less than would be expected to cause acute mortality. However, the effects of exposure to the complex mixtures of pesticides actually present are unknown.

The POD investigators initiated several studies [\*\*222] beginning in 2005 to address the possible role of contaminants and disease in the declines of Delta fish and other aquatic species. Their primary study consists of twice-monthly monitoring of ambient water toxicity at fifteen sites in the Delta and Suisun Bay. In 2005 and 2006, standard bioassays using the amphipod *Hyalella azteca* had low (<5 percent) frequency of occurrence of toxicity (Werner et al. 2008). However, preliminary results from 2007, a dry year, suggest the incidence of toxic events was higher than in the previous (wetter) years. Parallel testing with the addition of piperonyl butoxide, an enzyme inhibitor, indicated that both organophosphate and pyrethroid pesticides may have contrib-

uted to the pulses of toxicity. Most of the tests that were positive for *H. azteca* toxicity have come from water samples from the lower Sacramento River. Pyrethroids are of particular interest because use of these insecticides has increased within the Delta watershed (Ameg et al. 2005, Oros and Werner 2005) as use of some organophosphate insecticides has declined. Toxicity of sediment-bound pyrethroids to macroinvertebrates has also been observed in small, agriculture-dominated watersheds [\*\*223] tributary to the Delta (Weston et al. 2004, 2005). The association of delta smelt spawning with turbid winter runoff and the association of pesticides including pyrethroids with sediment is of potential concern.

In conjunction with the POD investigation, larval delta smelt bioassays were conducted simultaneously with a subset of the invertebrate bioassays. The water samples for these tests were collected from six sites within the Delta during May-August of 2006 and 2007. Results from 2006 indicate that delta smelt are highly sensitive to high levels of ammonia, low turbidity, and low salinity. There is some preliminary indication that reduced survival may be due to disease organisms (Werner et al. 2008). No significant mortality of larval delta smelt was found in the 2006 bioassays, but there were two samples [] collected from sites along the Sacramento River and had relatively low turbidity and salinity levels and moderate levels of ammonia. It is also important to note that no significant *H. azteca* mortality was detected in these water samples. While the *H. azteca* tests are very useful for detecting biologically relevant levels of water column toxicity for zooplankton, interpretation [\*\*224] of the *H. azteca* test results with respect to fish should proceed with great caution. The relevance of the bioassay results to field conditions remains to be determined.

[\*942] The POD investigations into potential contaminant effects also include the use of biomarkers that have been used previously to evaluate toxic effects on POD fishes (Bennett et al. 1995, Bennett 2005). The results to date have been mixed. Histopathological and viral

evaluation of young longfin smelt collected in 2006 indicated no histological abnormalities associated with exposure to toxics or disease (Foott et al. 2006). There was also no evidence of viral infections or high parasite loads. Similarly, young threadfin shad showed no histological evidence of contaminant effects or of viral infections (Foott et al. 2006). Parasites were noted in threadfin shad gills at a high frequency but the infections were not considered severe. Both longfin smelt and threadfin shad were considered healthy in 2006. Adult delta smelt collected from the Delta during the winter of 2005 also were considered healthy, showing little histopathological evidence for starvation or disease (Teh et al., unpublished data). However, there was some [\*\*225] evidence of low frequency endocrine disruption. In 2005, 9 of 144 (6 percent) of adult delta smelt males sampled were intersex, having immature oocytes in their testes (Teh et al., unpublished data).

In contrast, preliminary histopathological analyses have found evidence of significant disease in other species and for POD species collected from other areas of the estuary. Massive intestinal infections with an unidentified myxosporean were found in yellowfin goby *Acanthogobius flavimanus* collected from Suisun Marsh. Severe viral infection was also found in inland silverside and juvenile delta smelt collected from Suisun Bay during summer 2005. Lastly, preliminary evidence suggests that contaminants and disease may impair survival of age-0 striped bass. Baxter et al. 2008 found high occurrence and severity of parasitic infections, inflammatory conditions, and muscle degeneration in young striped bass collected in 2005; levels were lower in 2006. Several biomarkers of contaminant exposure including P450 activity (i.e., detoxification enzymes in liver), acetylcholinesterase activity (i.e., enzyme activity in brain), and vitellogenin induction (i.e., presence of egg yolk protein in blood [\*\*226] of males) were also reported from striped bass collected in 2006 (Ostrach 2008).

BiOp at 186-188.

It is not clear how the BiOp or any other document in the record links the impacts of contaminants to Project Operations. The BiOp does link the position of X2 to the extent of available delta smelt habitat, suggesting that a more confined habitat "may increase" the effects of contaminants:

During the fall, when delta smelt are nearing adulthood, the amount of suitable abiotic habitat for delta smelt is positively associated with X2. This results from the effects of Delta outflow on salinity distribution throughout the Estuary. Fall X2 also has a measurable effect on recruitment of juveniles the following summer in that it has been a significant covariate in delta smelt's stock-recruit relationship since the invasion of the overbite clam. Potential mechanisms for the observed effect are two-fold. First, positioning X2 seaward during fall provides a larger habitat area which presumably lessens the likelihood of density-dependent effects (e.g., food availability) on the delta smelt population. Second, a more confined distribution may increase the impact of stochastic events that increase mortality [\*\*227] rates of delta smelt. For delta smelt, this includes predation and anthropogenic effects [\*943] such as contaminants and entrainment (Sommer et al. 2007).

BiOp at 234. The Effects on Critical Habitat section states:

[T]hrough upstream depletions and alteration of river flows, the CVP/SWP has played a role in altering the environment of the Delta. This has resulted in adverse effects to delta smelt spawning habitat availability and may mobilize contaminants. The contaminant effects may be generated or diluted by flow depending on the amount of flow, the type of contaminant, the time of the year, and relative concentrations.

BiOp at 240.

FWS may only count indirect effects as effects of the action if they are "reasonably certain to occur." FWS's contaminants analysis does not demonstrate it has complied with this requirement. It must be done.

(8) Critical Habitat as Independent Basis for RPA.

Federal Defendants argue that, even if Plaintiffs demonstrate that the BiOp's "jeopardy" findings were arbitrary and capricious, the Court should nevertheless deny Plaintiffs' motion because the RPA is necessary to avoid adverse modification of the delta smelt's critical habitat. Doc. 660 at 55-58. The ESA requires, [\*\*228] once FWS finds the proposed agency action will result in "jeopardy or adverse modification [of critical habitat] ... the Secretary shall suggest those reasonable and prudent alternatives which [it] believes would not violate [Section 7(a)(2)] and can be taken by the Federal agency or applicant in implementing the agency action." 16 U.S.C. § 1536(b)(3)(A). Avoiding adverse modification of critical habitat is an independent statutory basis for promulgation of an RPA. Federal Defendants maintain that, in light of the statutory mandate to avoid both jeopardy and adverse modification, Plaintiffs must make a separate showing, independent of or in addition to their jeopardy arguments, that the BiOp's findings on critical habitat are also arbitrary and capricious. This is true in part. To support a finding that the adverse modification conclusion is arbitrary and capricious, Plaintiffs must demonstrate either that the underlying critical habitat analysis was independently flawed or that the critical habitat analysis was entirely dependent on flawed aspects of the jeopardy analysis. Whether or not the RPA and its constituent Actions are erroneous is a separate question.

The BiOp makes findings [\*\*229] concerning the impact of export pumping on delta smelt critical habitat, see BiOp at 190-202; 239-244, and concludes:

After reviewing the current status of delta smelt critical habitat, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the coordinated operations of the CVP and SWP, as proposed, are likely to adversely modify delta smelt critical habitat. The Service reached this conclusion based on the following findings, the basis for which is presented in the preceding Status of Critical Habitat/Environmental Baseline, Effects of the Action, and Cumulative Effects sections of this document.

1. The conservation role of delta smelt critical habitat is to provide migration, spawning and rearing habitat condi-

tions necessary for successful delta smelt recruitment at levels that will provide for the conservation of the species. Appropriate physical habitat (PCE 1), water (PCE 2), river flows (PCE 3), and salinity (PCE 4) are essential for successful delta smelt spawning and survival.

2. The past and present operations of the CVP/SWP have degraded these habitat [\*944] elements (particularly PCEs 2-4) to the extent that their co-occurrence at [\*\*230] the appropriate places and times is insufficient to support successful delta smelt recruitment at levels that will provide for the species' conservation.

3. Implementation of the proposed action is expected to perpetuate the very limited cooccurrence of PCEs at appropriate places and times by: (a) altering hydrologic conditions in a manner that adversely affects the distribution of abiotic factors such as turbidity and contaminants; (b) altering river flows to an extent that increases delta smelt entrainment at Banks and Jones, as well as reduces habitat suitability in the Central and South Delta; and (c) altering the natural pattern of seasonal upstream movement of the LSZ to an extent that is likely to reduce available habitat for the delta smelt within areas designated as critical habitat.

The proposed action does include a provision for VAMP to address augmentation of river flow but future implementation of this provision is not well defined, making its beneficial effects on the PCEs of delta smelt critical habitat uncertain.

4. On the basis of findings (1)-(3) above, the Service concludes that implementation of the proposed action is likely to prevent delta smelt critical habitat [\*\*231] from serving its intended conservation role.

BiOp 278-79.

Plaintiffs respond to Federal Defendants' argument that the critical habitat analysis is actually flawed in a number of ways:

(1) FWS failed to identify the threshold for adverse modification, or to assess and

explain whether the magnitude and extent of any claimed effects to critical habitat rise to that threshold level;

(2) in making finding 3(a), the BiOp did not provide analysis or explanation showing how alleged indirect effects to critical habitat will be caused by Project operations and will be reasonably certain to occur; and

(3) in making findings 3(b) and 3(c), FWS expressly relied on the flawed analyses of entrainment and X2.

Doc. 697 at 64-71:<sup>45</sup>

45 Federal Defendants' motion to strike these arguments on the ground that they were raised for the first time in Plaintiffs' reply brief was denied. Federal Defendants were afforded the opportunity to respond, *see* Doc. 745 at 2, which they did, *see* Doc. 746 at 2-7.

a. Identification of a Threshold For Adverse Modification/ Explanation of How Any Alleged Alteration To Critical Habitat Would Exceed that Threshold.

The BiOp's critical habitat findings 1 and 2 state that "appropriate" [\*\*232] habitat elements are "essential" and have been "degraded . . . to the extent that their co-occurrence at the appropriate places and times is insufficient to support successful delta smelt recruitment at levels that will provide for the species' conservation." BiOp at 278. However, Plaintiffs complain that the BiOp does not explain the extent of co-occurrence of habitat elements that is necessary for conservation of delta smelt; the magnitude of the claimed degradation of this co-occurrence that is attributable to Project operations; or why that effect renders the habitat elements "insufficient" to support the species' recovery. Plaintiffs argue, without such analysis there is no basis for FWS to conclude that habitat changes caused by Project operations will result in adverse modification of critical habitat.

[\*945] Destruction or adverse modification means "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species." 50 C.F.R. § 402.02. Previous rulings in related cases have held "that NMFS and FWS have interpreted the term 'appreciably diminish' to mean 'considerably reduce.'" Findings of Fact and Conclusions [\*\*233] of Law Re the Existence of Irreparable Harm, *PCFFA v. Gutierrez*, 1:06-cv-245 OWW GSA, Doc. 367 at 24:6-9 (citing Consultation Handbook at 4-34).

Plaintiffs cite *Gifford Pinchot*, 378 F.3d at 1074, and *NWF v. NMFS II*, 524 F.3d at 932 & n.10, for the principle that FWS must identify a threshold for adverse modification and assess and explain whether the magnitude and extent of any claimed effects to critical habitat reach that threshold. These cases do not support Plaintiff's argument. *Gifford Pinchot* rejected FWS's interpretation of "adverse modification" in a manner that only triggered an adverse modification finding where there is "an appreciable diminishment of the value of critical habitat for both survival and recovery." *Id.* at 1069. After rejecting FWS's rationale for applying the regulation, the Ninth Circuit reasoned that the various biological opinions at issue could nevertheless be found valid if they actually evaluated the impact to recovery. The *Gifford Pinchot* plaintiffs raised concerns about FWS's complete failure to address the issue of recovery in that biological opinion's critical habitat analysis. The Appeals Court specifically found that FWS detailed the percentage [\*\*234] loss of critical habitat but did not discuss the specific impact of that loss on recovery, rendering the BiOp insufficient. 378 F.3d at 1074.

Following *Gifford Pinchot*, *NWF v. NMFS II* held that NMFS acted arbitrarily and capriciously by failing to analyze the impacts of dam operations on the recovery value of critical habitat. 524 F.3d at 932. NMFS' argument "that it 'implicitly' analyzed recovery in its survival analysis" was rejected as a "post hoc justification," because a court cannot consider "an analysis that is not shown in the record." *Id.* at 932 n.10 (internal citations and quotations omitted). Plaintiffs do not directly challenge the BiOp's recovery analysis; rather, they argue that the BiOp should have set a "threshold" for adverse modification. Nothing in *Gifford Pinchot* or *NWF v. NMFS II* requires FWS to set a "threshold" for adverse modification.

*Butte Environmental Council v. U.S. Army Corps of Engineers*, 607 F.3d 570, 582-83 (9th Cir. 2010), suggests exactly the opposite. *Butte* upheld FWS's determination that destruction of a very small percentage (less than 1%) of designated critical habitat would not adversely modify the species' critical habitat. Relevant here is the [\*\*235] Ninth Circuit's rejection of a demand that FWS address the rate of loss of critical habitat, finding that nothing in the statute or regulations requires FWS to perform such a calculation. *Id.*

Plaintiffs extensively discuss the BiOp's critical habitat analysis to attempt to demonstrate the BiOp does not identify a threshold for adverse modification or what standard for adverse modification FWS applied. *See* Doc. 697 at 66-69. Plaintiffs criticize the individual critical habitat findings for failing to clearly describe the effects of project operations on the quantity or quality of the individual habitat elements.

This disassembly, focusing on the critical habitat conclusion, does not consider the BiOp as a whole. The BiOp's adverse modification determination relies on four components: "(1) the Status of Critical Habitat... ; (2) the Environmental Baseline... ; (3) the Effects of the Action... ; and (4) Cumulative Effects...." BiOp at [\*946] 139. The Status of the Species/Environmental Baseline sections analyze how project operations have degraded the PCEs up to the present time, while the Effects Analysis analyzes how these ongoing operations will continue to adversely modify critical habitat [\*236] in the future. *See id.* at 202-203. Most of the impacts analysis is found in the Status of the Species / Environmental Baseline section. The Effects Analysis explains that these well-documented prior effects will continue due to ongoing Project operations. *Id.*

In the discussion of PCE # 2 (water quality, including abiotic elements), the BiOp explains how this PCE's condition is substantially degraded by Project operations. FWS found that project operations cause "[p]ersistent confinement of the effective spawning population" and otherwise "adversely affect" turbidity, "reproductive success," the availability of prey, and the exposure of delta smelt to contaminants and to localized catastrophic events. *Id.* at 197. Plaintiffs' omnibus complaint that the critical habitat section entirely lacks analytical structure is overbroad.

**b. Reliance On Assumptions Of Indirect Effects Without Providing Evidence That These Indirect Effects Are Reasonably Certain To Occur.**

Plaintiffs argue BiOp critical habitat finding 3(a), BiOp at 278, is flawed as unsupported by any analysis verifying that Project-induced changes to Delta hydrodynamics interact with other abiotic factors to exacerbate the effects of [\*237] those factors on the delta smelt's critical habitat. Plaintiffs assert the BiOp's conclusory assertions do not explain how described indirect effects to critical habitat are reasonably certain to occur. *See 50 C.F.R. § 402.02* (requiring that indirect effects be reasonably certain to occur).

The BiOp concludes the impact of Project Operations on PCE 2 (Water), "[a]s described in the Effects Section, the CVP/SWP alter the hydrologic conditions within spawning habitat throughout the spawning period for delta smelt by impacting various abiotic factors including the distributions of turbidity, food, and contaminants." BiOp at 239; *see also* BiOp at 241 ("In addition, pumping at Banks and Jones can alter flows within the Delta. This results in a corresponding alteration of larval and juvenile transport."); BiOp at 242 ("As described in the Effects Section, the CVP/SWP alter the hydrologic conditions within rearing habitat throughout the spawning period for delta smelt by impacting various abiotic

factors including distributions of turbidity, food, and contaminants."); *id.* ("Pumping at Banks and Jones alters flows within the Delta. As described in the Effects Section, negative flows can result [\*238] in an increased risk of entrainment when rearing habitat includes the South Delta."); BiOp at 243 ("As stated previously, the CVP/SWP alters the extent and location of the LSZ by modifying both the Sacramento and San Joaquin river flows which reduces habitat quality and quantity).).

The BiOp links export pumping and contaminant effects:

The CVP and SWP, as analyzed in the Effects Section, directly influence the location and the amount of suitable spawning habitat, especially in drier WYs. Further, through upstream depletions and alteration of river flows, the CVP/SWP has played a role in altering the environment of the Delta. This has resulted in adverse effects to delta smelt spawning habitat availability and may mobilize contaminants. The contaminant effects may be generated or diluted by flow depending on the amount of flow, the type of contaminant, the time of the year, and relative concentrations.

BiOp at 239. Although, the BiOp supports the conclusion that the Projects drive hydrodynamics [\*947] during times of balanced conditions, nowhere in the BiOp or in any record citation provided by any party is there any support for the conclusion that Project operations are reasonably certain to [\*239] exacerbate contaminant impacts. It is logical that changes in hydrodynamics could impact exposure to contaminants in the water, but the extent of this influence is unknown and unsupported by any analysis or record citation.

**c. Reliance on Analysis Of Entrainment and X2 in Support of the Adverse Modification Determination.**

Plaintiffs opening brief argued: "the BiOp's determination that proposed Project Operations will adversely modify critical habitat rests upon the same defective Project Effects Analysis that led FWS to its determination that Project Operations would jeopardize the delta smelt." Doc. 551 at 63. The critical habitat conclusion section does explicitly rely on conclusions reached in the effects analysis' regarding entrainment and the movement of X2. For example, Critical Habitat conclusion #3 provides:

3. Implementation of the proposed action is expected to perpetuate the very limited co-occurrence of PCEs at appropriate places and times by: (a) altering hydrologic conditions in a manner that adversely affects the distribution of abiotic factors such as turbidity and contaminants; (b) altering river flows to an extent that increases delta smelt entrainment at Banks and Jones, [\*\*240] as well as reduces habitat suitability in the Central and South Delta; and (c) altering the natural pattern of seasonal upstream movement of the [Low Salinity Zone ("LSZ")] to an extent that is likely to reduce available habitat for the delta smelt within areas designated as critical habitat.

BiOp at 278.

The BiOp's general conclusion that Project Operations increase delta smelt entrainment with resulting population-level impacts within year classes is valid. It is, rather, the BiOp's quantitative conclusions regarding the exact negative OMR flow ranges that are unfounded. FWS did not err by incorporating this general conclusion in its Critical Habitat conclusion.

As for the inclusion of the finding that Project Operations alter the natural pattern of seasonal movement of the Low Salinity Zone ("LSZ"), this underlying conclusion from the Effects section is not supported by the record, because it is based at least in part on the invalid quantitative analysis using the Calsim II to Dayflow comparison. This aspect of the critical habitat analysis is without record support. These areas must be addressed on remand.

#### (9) Discretionary v. Nondiscretionary Actions.

Plaintiffs complain that the BiOp's [\*\*241] Project Effects analysis was "tainted" because it does not distinguish between discretionary and non-discretionary actions. Doc. 551 at 61-63. *National Association of Home Builders v. Defenders of Wildlife*, 551 U.S. 644, 127 S. Ct. 2518, 168 L. Ed. 2d 467 (2008), held that ESA § 7's consultation requirements do not apply to non-discretionary actions. Where an agency is required by law to perform an action, it lacks the power to insure that the action will not jeopardize the species. *Id.* at 667. Plaintiffs' cite the Coordinated Operations Agreement, the Central Valley Project Improvement Act's ("CVPIA") requirements to deliver water for Central Valley wildlife refuge areas, and D-1641 as examples of mandatory aspects [\*\*948] of Project operations that,

they claim, should have been segregated from other Project Operations in the Project Effects Analysis.

However, *Home Builders* does not address whether, once section 7 consultation is triggered, the jeopardy analysis must separately identify and segregate discretionary from non-discretionary actions, relegating the non-discretionary actions to the environmental baseline. *Home Builders* addressed whether the section 7 consultation obligation attaches to a particular agency action at [\*\*242] all. *See Home Builders*, 551 U.S. at 669-70 (holding that consultation "duty does not attach to actions... that an agency is required by statute to undertake...") (emphasis added). Plaintiffs do not suggest that section 7 does not apply to the coordinated operations of the Projects. Rather, Plaintiffs contend that the section 7 consultation process requires distinguishing between discretionary and non-discretionary Project operations to identify the actions not subject to Section 7. Neither *Home Builders* nor the regulation interpreted in *Home Builders*, 50 C.F.R. § 402.03, includes any such requirement. Plaintiffs' motion for summary judgment that the BiOp unlawfully failed to distinguish between discretionary and non-discretionary actions is DENIED. This does not mean non-discretionary actions required by law must not be considered in the consultation process. Federal Defendants and Defendant-Intervenors' cross-motion on identification of non-discretionary actions is GRANTED.

#### B. Application of the RPA Regulations.

Plaintiffs next argue that, in adopting the RPA, Federal Defendants did not undertake the analysis required by Section 7 and its Joint Consultation Regulations. Doc. 551 at [\*\*243] 65-79. Under the ESA, if a biological opinion concludes that a proposed agency action will cause jeopardy to a listed species or result in the destruction or adverse modification of its critical habitat, "the Secretary shall suggest those reasonable and prudent alternatives which he believes would not violate subsection (a)(2) and can be taken by the Federal agency or applicant in implementing the agency action." 16 U.S.C. § 1536(b)(3)(A); 50 C.F.R. § 402.14(h)(3). The Joint Consultation Regulations define such reasonable and prudent alternatives as follows:

Reasonable and prudent alternatives refer to alternative actions identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction, that is [sic] economically and technologically feasible, and that the Di-

rector believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

50 C.F.R. § 402.02; see also 51 Fed. Reg. at 19,958; 50 C.F.R. § 402.14(g)(5); *Home Builders*, 551 U.S. at 652 [\*\*244] (Section 402.02 defines what qualifies as an RPA). Under this definition, an RPA must: (1) be consistent with the purpose of the underlying action; (2) be consistent with the action agency's authority; (3) be economically and technologically feasible; and (4) avoid the likelihood of jeopardy to the species or adverse modification of its critical habitat. 50 C.F.R. § 402.02; see also 16 U.S.C. § 1536(b)(3)(A); *Greenpeace v. Nat'l Marine Fisheries Serv.*, 55 F. Supp. 2d 1248, 1264 (W.D. Wash. 1999).

(1) FWS Did Not Explicitly Analyze Any of the Four Factors in the BiOp.

It has already been determined that "the BiOp does not explicitly discuss the [\*\*949] first three factors -- consistency with the purpose of the action; consistency with the legal authority and jurisdiction of the action agency; and economic and technological feasibility -- at all." Memorandum Decision Re Cross Motions for Summary Judgment Re Reasonable and Prudent Alternative Claims, Doc. 354 at 16 ("None of the terms 'consistent with the intended purpose of the action,' 'jurisdiction,' 'legal authority,' or 'economically and technologically feasible,' are used in the RPA section of the BiOp."). "[I]t is undisputed that the BiOp's [\*\*245] language contains no such discussion." *Id.* at 21.

An October 15, 2009 Decision rejected Plaintiffs' earlier argument that this analysis must be included "on the face" of the BiOp. See Doc. 354 at 38. However, the question of whether FWS properly promulgated the RPA was left to be "decided on the basis of the entire record." *Id.* at 51. Of the four requirements, "[j]eopardy has been found to be the 'guiding standard' for determination of RPAs." *Id.* at 27 (citing *Greenpeace* 55 F. Supp. 2d at 1268). Whether and how the record must demonstrate compliance with § 402.02 is a separate question.

(2) Compliance with § 402.02.

Plaintiffs allege that FWS violated the APA because the administrative record contains no meaningful analysis related to the first three requirements of § 402.02, and that, while FWS undertook some analysis regarding whether its RPA would avoid jeopardizing delta smelt (the fourth factor described in § 402.02), that analysis is

flawed because it was not based upon the best available science.

a. Jeopardy Factor (Fourth Factor).

Plaintiffs maintain that FWS violated the ESA by adopting its RPA without providing a reasoned analysis regarding how the various RPA actions will avoid [\*\*246] the likelihood of jeopardizing the delta smelt or adversely modifying its critical habitat. The Consultation Handbook directs that "[w]hen a reasonable and prudent alternative consists of multiple activities, it is imperative that the opinion contain a thorough explanation of how each component of the alternative is essential to avoid jeopardy." Consultation Handbook at 4-43. Plaintiffs do not dispute that the BiOp contains extensive discussion of the need for the RPA components. Rather, Plaintiffs contend that the RPA violates § 402.2 because that discussion is not based on the best available science.

The § 402.02 requirements and the best available science requirement are separate. It is undisputed that both the BiOp and its RPA must be based on the best available science, but a violation of that requirement does not necessarily violate § 402.02. Whether each part of the jeopardy analysis relies on the best available science is discussed above. Section 402.02 does not provide an independent statutory basis for imposing liability upon FWS for failing to comply with the best available science requirement. Plaintiffs' motion for summary judgment on this ground is DENIED; Federal Defendants' [\*\*247] and Defendant-Intervenors' is GRANTED.

b. Non-Jeopardy Factors (Factors One Through Three).

It is undisputed that the BiOp contains no explicit discussion of the first three factors: (1) consistency with the purpose of the underlying action; (2) consistency with the action agency's authority; and (3) economic and technological feasibility. Plaintiffs insist that the ESA and its implementing regulations require that the record contain explicit "analyses" of each of the four factors. As authority, Plaintiffs invoke general principles of Administrative [\*\*950] Law, including the rule that a court "cannot infer an agency's reasoning from mere silence." See *PCFFA*, 426 F.3d at 1091.

It is undisputed that there is no explicit analysis anywhere in the record of the three non-jeopardy factors. Federal Defendants and Defendant-Intervenors dismiss this fact, arguing (1) that no such explicit analysis is required by law and (2) that satisfaction of all three factors is so obvious that explicit analysis is unnecessary. See Doc. 660 at 70-72; Doc. 661-3 at 35-38.

Many of the cases upon which the parties now rely were discussed in the October 15, 2009 Decision:

Plaintiffs and DWR rely on caselaw to support their [\*\*248] contention that, despite the lack of an explicit requirement, the BiOp must include findings treating the first three RPA requirements. It is undisputed that an agency acts arbitrarily and/or capriciously when it fails to consider an important aspect of a problem before it. *Pac. Coast Fed'n of Fishermen's Ass'ns v. NMFS*, 265 F.3d 1028, 1034 (9th Cir. 2001) ("*PCFFA I*"). But, whether an agency must expressly consider any particular issue on the face of its decisional document, as opposed to elsewhere in the administrative record, is a different question. On the one hand, an agency action may be upheld even if it is of "less than ideal clarity" as long as "the agency's path may reasonably be discerned." *Bowman Transp., Inc. v. Arkansas-Best Freight System, Inc.*, 419 U.S. 281, 285-86, 95 S. Ct. 438, 42 L. Ed. 2d 447 (1974). However, a court "cannot infer an agency's reasoning from mere silence..." but must "rely only on what the agency actually said...." *Compare Gifford Pinchot Task Force v. U.S. Fish and Wildlife Serv.*, 378 F.3d 1059, 1072 n.9 (9th Cir. 2004) (holding that the court "may only rely on what the agency said in the record to determine what the agency decided and why"); *Pac. Coast Fed'n of Fishermen's Ass'ns v. NMFS*, 426 F.3d 1082, 1092 (9th Cir. 2005) [\*\*249] ("*PCFFA II*") (citing *Gifford Pinchot* for the proposition that a court must "rely only on what the agency actually said in the biological opinion"). Does the caselaw require that the RPA requirements be discussed on the face of the BiOp?

Plaintiffs place great weight on the Ninth Circuit's decision in *Southwest Center for Biological Diversity v. U.S. Bureau of Reclamation*, 143 F.3d 515, 518 (9th Cir. 1998), upholding a FWS biological opinion concluding that Reclamation's operations on Lake Mead and the Lower Colorado River would jeopardize an endangered bird species, the Southwestern Willow Flycatcher. Before the BiOp was finalized, FWS sent Reclamation a draft RPA comprised of a number of short and long-term components. *Id.* Some of the short-term measures would have required

Reclamation to lower the level of Lake Mead. Reclamation advised FWS that it lacked discretion to do so. *Id.* FWS's final BiOp confirmed that project operations would jeopardize the species, but proposed a new RPA which no longer required Reclamation to take the originally-proposed short term actions, replacing them with other short term measures. *Id.*

Environmental plaintiffs argued that FWS improperly rejected the [\*\*250] draft RPA in favor of the final RPA, which does less to preserve habitat near Lake Mead, "based on Reclamation's alleged lack of discretion to lower the level of Lake Mead." *Id.* at 523. Specifically, Plaintiffs complained "that the secretary never independently reviewed Reclamation's [\*951] representation that it lacked such discretion." *Id.*

The Ninth Circuit rejected this argument on several grounds. First, "under the ESA, the Secretary was not required to pick the first reasonable alternative the FWS came up with in formulating the RPA. The Secretary was not even required to pick the best alternative or the one that would most effectively protect the Flycatcher from jeopardy.... The Secretary need only have adopted a final RPA which complied with the jeopardy standard and which could be implemented by the agency." *Id.* at 523 (emphasis added).

Second, "under the ESA, the Secretary was not required to explain why he chose one RPA over another, or to justify his decision based solely on apolitical factors.[FN5]" *Id.* Footnote 5 further explains:

The Secretary must rely on "the best scientific and commercial data available" in formulating an RPA, 16 U.S.C. § 1536(a)(2). However, the ESA does not [\*\*251] explicitly limit the Secretary's analysis to apolitical considerations. If two proposed RPAs would avoid jeopardy to the Flycatcher, the Secretary must be permitted to choose the one that best suits all of its

interests, including political or business interests.

*Id.*

The Ninth Circuit then articulated the governing standard: "The only relevant question before [the court] for review was whether the Secretary acted arbitrarily and capriciously or abused his discretion in adopting the final RPA." *Id.* "In answering this question, the court had only to determine if the final RPA met the standards and requirements of the ESA. The court was not in a position to determine if the draft RPA should have been adopted or if it would have afforded the Flycatcher better protection." *Id.*

The Ninth Circuit reviewed the evidence and found no APA violation:

Upon careful review of the evidence, we cannot say the district court erred in finding that the final RPA met the standards and requirements of the ESA. The district court determined that the FWS considered the relevant factors and reasonably found that the Flycatcher could survive the loss of habitat at Lake Mead for eighteen months until 500 acres could [\*252] be protected, then survive an additional two years until an additional 500 acres could be protected, and finally survive through the MSCP process until compensation could be made for the historical habitat lost on the Lower Colorado River and until an extensive ecological restoration could be undertaken. Southwest failed to present any convincing evidence to contradict the FWS' findings. Southwest merely relied upon the discarded draft RPA which had indicated

that preservation of the Lake Mead habitat was necessary to the survival of the Flycatcher. However, upon further consideration of the matter, the FWS was entitled to, and did, in fact, change its mind. The FWS concluded in the final BO that the proposed short-term and long-term provisions of the final RPA would avoid jeopardy to the Flycatcher, notwithstanding the failure to modify Reclamation's operation of Hoover Dam at Lake Mead. Because there was a rational connection between the facts found in the BO and the choice made to adopt the final RPA, and because we must defer to the special expertise of the FWS in drafting RPAs that will sufficiently [\*952] protect endangered species, we cannot conclude that the Secretary violated the [\*\*253] APA.

*Id.* (emphasis added).

Plaintiffs argue the emphasized text, approving FWS's RPA because there was a rational connection between the facts "found in the BiOp" and that decision, establishes that the FWS must make findings on all four RPA requirements on the face of the BiOp. This overstates the Ninth Circuit's holding. First, *Southwest Center* says nothing about requiring findings on the face of the BiOp. The requisite findings were, unsurprisingly, in the BiOp in that case, because those findings concerning how each component of the final RPA would avoid jeopardy, were explicitly required by the Consultation Handbook. Consultation Handbook 4-41 ("When a reasonable and prudent alternative consists of multiple activities, it is imperative that the opinion contain a thorough explanation of how each component of the alternative is essential to

avoid jeopardy and/or adverse modification." (emphasis added). Neither the Handbook, the ESA, nor any of its implementing regulations explicitly require that the BiOp contain an analysis of any of the other three RPA requirements.

Plaintiffs suggest the second sentence from the *Southwest Center* language delineates that findings are required for [\*\*254] all four RPA requirements. Plaintiffs quote that sentence as authority to claim the "FWS considered the relevant factors and reasonably found[]" the Joint Consultation Regulations requirements were satisfied with respect to an RPA issued in a biological opinion for the Southwest Willow Flycatcher.... Doc. 237 at 10. This is misleading, because the entire sentence makes clear that the only "findings" discussed in *Southwest Center* were findings concerning the capacity of the Flycatcher to survive in the short term while the RPA was being implemented. 143 F.3d at 523. *Southwest Center* only stands for the proposition that FWS must justify its conclusion that the RPA would prevent jeopardy and/or adverse modification in the BiOp. See *Greenpeace*, 55 F. Supp. 2d at 1268 (finding the jeopardy determination to be the "guiding standard" for determination of RPAs). *Southwest Center* does not create the discussion requirement Plaintiffs suggest.

*PCFFA II*, on which Plaintiffs also rely, is not contrary. 426 F.3d 1082. There, the Ninth Circuit overturned an RPA adopted for coho salmon because NMFS failed to articulate the bases for its assumptions underlying the RPA. *Id.* at 1090-95. The district [\*\*255] court concluded that the agency had "implicitly considered" whether all three phases of the RPA would ensure against jeopardy. *Id.* at 1091. The Ninth Circuit emphasized that "it is a basic principle of administrative law that the agency must articulate the reason or reasons for its decision." *Id.*

The Ninth Circuit found "little substance to the discussions of Phases I and II" in the BiOp. *Id.* at 1093. Although some language suggested that "the agency believed that the RPA would avoid jeopardy to the coho, this assertion alone is insufficient to sustain the BiOp and the

RPA." *Id.* The Ninth Circuit refused to "take [the agency's] word that the species will be protected if its plans are followed." *Id.* As in *Southwest Center*, *PCFFA II* only discussed whether the RPA would avoid jeopardy, the analysis of which is explicitly required in the BiOp. Here, Plaintiffs seek to extend this logic to mandate that FWS include specific findings concerning [\*\*953] the three other RPA requirements in the BiOp. *PCFFA II* does not require this.

Plaintiffs also cite *NRDC v. Kempthorne*, 506 F. Supp. 2d 322 (E.D. Cal. 2007), which held that, although certain, potentially critical data was part of the administrative record, [\*\*256] its significance, or lack thereof, was not discussed in the BiOp. *Id.* at 362-363. The government's post hoc reasoning was rejected, that, even if the data had been addressed in the BiOp, the ultimate opinion reached by the Service would not have been different. "Although a decision of less than ideal clarity may be upheld if the agency's path may reasonably be discerned, [a court] cannot infer an agency's reasoning from mere silence. Rather, an agency's action must be upheld, if at all, on the basis articulated by the agency itself." *Id.* at 366 (citing *PCFFA*, 426 F.3d at 1091). The district court further reasoned "[h]ad FWS examined the FMWT 2004 data in the BiOp, the weight it gave to that data would have been entitled to deference. The agency's silence cannot be afforded deference." *Kempthorne*, 506 F. Supp. 2d at 366.

Plaintiffs argue that this language reflects a requirement that analysis of the data must be included in the BiOp, suggesting that if such analysis was instead found elsewhere in the administrative record it would be insufficient. This reads too much into *Kempthorne*, where the necessary reasoning was found in neither the BiOp nor the administrative record. *Id.* at 380 [\*\*257] (district court searched for, but did not find, certain analyses in the BiOp or "elsewhere in the administrative record"). *Kempthorne* found the content of the BiOp lacking in light of the entire AR, both of which entirely failed to competently perform the required ESA

jeopardy and habitat modification analyses. The practical fact is that a BiOp is much more accessible than the administrative record, which can be tens of thousands of pages long. *Kemphorne* did not address or decide the issue presented here.

In APA review cases, it is well established that, in determining whether agency action was "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.... the court shall review the whole record or those parts of it cited by a party, and due account shall be taken of the rule of prejudicial error." 5 U.S.C. § 706. The "whole record," includes "everything that was before the agency pertaining to the merits of its decision." *Portland Audubon Soc'y v. Endangered Species Committee*, 984 F.2d 1534, 1548 (9th Cir. 1993). See also *Seattle Audubon Soc'y v. Lyons*, 871 F. Supp. 1291, 1308 (W.D. Wash. 1994) (finding declarations properly considered to "explain the [\*\*258] agency's actions or to determine whether its course of inquiry was inadequate.").

DWR's cases do not undermine this reasoning. *Motor Vehicle Manufacturers Association of the United States, Inc., v. State Farm Mutual Auto Insurance Company*, 463 U.S. 29, 103 S. Ct. 2856, 77 L. Ed. 2d 443 (1983), concerned the National Highway Traffic Safety Administration's ("NHTSA") decision to rescind passive restraint crash safety requirements for new motor vehicles. When NHTSA learned that automakers opted to install automatic seatbelts which users could easily detach, the agency rescinded the order in light of the expense required to implement a program that would have only minimal safety benefits because it could be disengaged by users. *Id.* at 38-39. The Court concluded that this [\*954] decision was arbitrary and capricious because NHTSA failed to consider modifying the standard to require the installation of airbags. *Id.* at 46. In reaching this conclusion, the Court indicated it must "consider whether the decision was based on a consideration of the relevant factors and whether there has been a clear error of judgment." *Id.* (emphasis added).

Focusing on *State Farm's* use of the word "decision," DWR asserts that all relevant factors must [\*\*259] be considered in the text of the agency's decision document, rather than elsewhere in the administrative record. But, *State Farm* also emphasized that the relevant statute required a "record of the rulemaking proceedings to be compiled," *id.* at 43-44, and indicated that "Congress established a presumption against.... changes in current policy that are not justified by the rule-making record," *id.* at 43. *State Farm* does not support DWR's position that the "whole record" rule should be ignored in favor of a requirement that any and all analytical reasoning must be included in the decision document (the BiOp).

DWR also relies on *Burlington Truck Lines, Inc. v. United States*, 371 U.S. 156, 168-69, 83 S. Ct. 239, 9 L. Ed. 2d 207 (1962), which criticized the Interstate Commerce Commission's ("ICC") failure to make any findings or include any analysis to justify a particular decision. The Court noted that "expert discretion is the lifeblood of the administrative process, but unless we make the requirements for administrative action strict and demanding, expertise, the strength of modern government, can become a monster which rules with no practical limits on its discretion." *Id.* at 167 (internal citations and quotations omitted). [\*\*260] See also *Ry. Labor Executives' Ass'n v. ICC*, 784 F.2d 959, 974 (refusing to "rummage around in the record below to find a plausible rationale to fill the void in the agency order under review"). *Burlington and Railway Labor Executives'* insistence upon formal findings is unsurprising given that, under the procedures applicable in that case, where the ICC was required to "make findings that support its decision, and those findings must be supported by substantial evidence." *Id.* No such general findings requirement exists here. Rather, the only findings explicitly required by the Consultation Handbook are those concerning the capacity of any RPA to prevent jeopardy and/or adverse modification.

A statute or regulation may specifically require certain reasoning or findings

to be included in the ultimate decision document. The above-mentioned requirement that the BiOp explain why each part of a multi-part RPA ensures against jeopardy or adverse modification is one such example. However, there is no parallel requirement that FWS certify or make findings with respect to the other three RPA requirements on the fac[e] of the record. It is not appropriate for a court to "create[] a requirement [\*\*261] not found in any relevant statute or regulation." *The Lands Council v. McNair*, 537 F.3d 981, 991 (9th Cir. 2008). Rather, the issue of whether FWS properly promulgated the RPA must be decided on the basis of the entire record.

Doc. 354 at 38-51 (footnotes omitted, emphasis in original). Plaintiffs' argument that the three non-jeopardy factors must be explicitly analyzed on the face of the BiOp was rejected, but the question of how the three non-jeopardy factors must be treated elsewhere [\*955] in the record was left open. Must an explicit analysis of the three factors be included in the record? Or may evidence in the record itself, even absent explicit analysis, be relied upon to evaluate whether the RPA satisfies the three factors? The October 15, 2009 Decision recognizes a dichotomy in the caselaw:

On the one hand, an agency action may be upheld even if it is of "less than ideal clarity" as long as "the agency's path may reasonably be discerned." *Bowman Transp., Inc. v. Arkansas-Best Freight System, Inc.*, 419 U.S. 281, 285-86, 95 S. Ct. 438, 42 L. Ed. 2d 447 (1974). However, a court "cannot infer an agency's reasoning from mere silence..." but must "rely only on what the agency actually said...." *Compare Gifford Pinchot Task Force v. U.S. Fish and Wildlife Serv.*, 378 F.3d 1059, 1072 n.9 (9th Cir. 2004) [\*\*262] (holding that the court "may only rely on what the agency said in the record to determine what the agency decided and why"); *Pac. Coast Fed'n of Fishermen's Ass'ns v. NMFS*, 426 F.3d 1082, 1092 (9th Cir. 2005) ("*PCFFA II*") (citing *Gifford Pinchot* for the proposition that a court must "rely only on what the agency actually said in the biological opinion").

*Id.* at 39.

Defendants acknowledge that the agency must explicitly analyze the jeopardy factor, but claim that it is permissible for the agency not to address the non-jeopardy factors anywhere in the administrative record. To accept Defendants' view would be to abdicate the judicial review function. Even though the jeopardy factor is the "guiding standard" for the adoption of an RPA, *see Greenpeace*, 55 F. Supp. 2d at 1268, this does not eviscerate the other three § 402.02 factors. *Greenpeace* rejected the contention that the "economically and technologically feasible" language required the agency to "balance the benefit to the species against the economic and technical burden on the industry before approving an RPA," because such a conclusion would be inconsistent with the purposes of the ESA under *TVA v. Hill*. *Id.* *Greenpeace* confirms that [\*\*263] 50 C.F.R. § 402.02 "contains four distinct requirements for any valid RPA," *id.* at 1264, and that FWS "must come up with [RPAs] that are consistent with the purposes of the underlying action and the action agency's authority, that are economically and technologically feasible, and which avoid the likelihood of jeopardy and adverse modification." *Id.*

According to *PCFFA*, a court should "sustain an agency action if the agency has articulated a rational connection between the facts found and the conclusions made." 426 F.3d at 1090 (citing *Motor Vehicle Mfrs. Ass'n*, 463 U.S. at 43).

"Even when an agency explains its decision with 'less than ideal clarity,' a reviewing court will not upset the decision on that account 'if the agency's path may reasonably be discerned.'" *Alaska Dep't of Env't'l Conserv. v. EPA*, 540 U.S. 461, 497, 124 S. Ct. 983, 157 L. Ed. 2d 967 (2004) (quoting *Bowman Transp., Inc. v. Arkansas-Best Freight Sys., Inc.*, 419 U.S. 281, 286, 95 S. Ct. 438, 42 L. Ed. 2d 447 (1974)).

While our review is deferential, our inquiry must "be searching and careful." *Marsh*, 490 U.S. at 378. We must determine whether the agency's decision was "based on a consideration of the relevant factors and whether there has been a clear error of judgment." *Id.*

*Id.* Here, [\*\*264] the agency has articulated absolutely no connection between the facts in the record and the required conclusion [\*956] that the RPA is (1) consistent with the purpose of the underlying action; (2) consistent with the action agency's authority; and (3)

economically and technologically feasible. The record here is not just an explanation of "less than ideal clarity." There is no explanation at all

Defendants offer a number of post hoc rationalizations for the RPA. Defendant-Intervenors argue that the record demonstrates the RPA can be implemented in a manner consisted "with the intended purpose of the action" and "within the scope of the Federal agency's legal authority and jurisdiction," because, by letter dated December 15, 2008, the Bureau "provisionally accept[ed]" most portions of the RPA and stated that Components 3 and 4 "both need additional review and refinement before Reclamation will be able to determine whether implementation of these actions by the Projects is reasonable and prudent." *NRDC v. Kempthorne*, 1:05-cv-01207 OWW GSA, Doc. 767-1. Defendant-Intervenors conclude that the Bureau has made no determination that the RPA is inconsistent with the purpose of the action or with its [\*\*265] legal authority and jurisdiction. Doc. 661-3 at 38. They suggest as to economic and technological feasibility, that these requirements must have been considered because, based on concerns expressed by the Bureau, the RPA was modified to be more flexible.<sup>46</sup> *Id.* at 37.

46 For example, OMR flows under Components 1 and 2 are to be calculated based on a 14-day running average, compared to the 7-day average under the interim remedial order. *See* BiOp at 168, 280-82. The turbidity trigger for Action 1 of Component 1 is now based on a 3-day average at three stations in the Delta, compared to one station under the Court's interim remedial order, to "better reflect a Delta-wide change in turbidity than one station which may be prone to localized conditions." BiOp at 281, 347.

But, the record provides none of these explanations.<sup>47</sup> FWS is ultimately responsible to ensure that the record supports the RPA. FWS explained in the preamble to its final rule adopting the Joint Consultation Regulations:

[I]n those instances where the Service disagrees with a Federal agency's assessment of the reasonableness of its alternatives, the Service must reserve the right to include those alternatives in the biological [\*\*266] opinion if it determines that they are "reasonable and prudent" according to the standards set out in the definition in § 402.02; the Service cannot abdicate its ultimate duty to formulate these alternatives by giving Federal agencies control over the content of a biological opinion.

51 *Fed. Reg.* 19,926, 19,952 (June 3, 1986). Even if, *arguendo*, the RPA is consistent with the multiple purposes of the action [\*\*957] and the agency's statutory authority, and is economically and technologically feasible to implement, the APA requires, and the public is entitled under the law to receive, some exposition in the record of why the agency concluded (if it did so at all) that all four regulatory requirements for a valid RPA were satisfied. The RPA Actions manifestly interdict the water supply for domestic human consumption and agricultural use for over twenty million people who depend on the Projects for their water supply. "Trust us" is not acceptable. FWS has shown no inclination to fully and honestly address water supply needs beyond the species, despite the fact that its own regulation requires such consideration.

47 The specific requirements of the X2 action are another example of how the record [\*\*267] fails to address the "consistency with the intended purpose of the action," and is "within the scope of the ... agency's authority and jurisdiction." 50 *C.F.R.* § 402.02. Because of competing demands for water from the Projects, combined with a limited supply, one purpose of the Projects is to ensure that that water use and allocation be carefully managed, and to also ensure that water is put to a beneficial use and not wasted. This purpose is, in fact, required by California law, *Cal. Const. art. X, §2*; *Cal. Water Code* § 275, and imposed upon federal project operations by virtue of Section 8 of the Reclamation act of 1902. 43 *U.S.C.* § 383. The Projects will have to expend hundreds of thousands of acre feet of water to maintain X2 as far seaward as Component 3 requires. Miller Decl., Doc. 400, at ¶ 67-73. Less water would be required if X2 did not need to be pushed so far downstream--water would then be available for other uses. Yet nothing in the BiOp or the record explains why it is essential that X2 be moved seaward to the degree required by Component 3 in order to protect the smelt and its habitat.

How the appropriation of water for the RPA Actions, to the exclusion of implementing [\*\*268] less harmful alternatives, is required for species survival is not explained. The appropriate remedy for such a failure to explain is remand to the agency. *See Sears Sav. Bank v. Federal Sav. and Loan Ins. Corp.* 775 *F.2d* 1028, 1030 (9th Cir. 1985) ("If the administrative record is inadequate to explain the action taken, the preferred practice is to remand to the agency for amplification."). Plaintiffs' motion for summary judgment that FWS violated §

402.02 is GRANTED; Defendants' cross-motion is DENIED.

c. There is no Procedural Requirement that FWS Accept, Consider, and/or Address Comments Regarding the BiOp or its RPA.

Neither the ESA nor its implementing regulations require an opportunity for public comment or that FWS respond to any comments received. *See Kandra v. United States*, 145 F. Supp. 2d 1192, 1209 n.8 (D. Or. 2001) ("as the government correctly pointed out during oral argument, the ESA does not require public review or input during the consultation process"); *Ctr. for Biological Diversity v. Kempthorne*, 2008 U.S. Dist. LEXIS 17517, 2008 WL 659822, \*7 (D. Ariz. Mar. 6, 2008) ("Biological opinions, unlike DPS findings, are not subject to notice and comment rulemaking procedures pursuant to the ESA."). [\*\*269] Plaintiffs' suggestion that FWS violated the ESA by "ignoring" comments on the draft BiOp is legally unsustainable. Plaintiffs' motion on this ground is DENIED; Defendants' cross-motion is GRANTED.

C. Stewart & Jasper Orchards' Argument Re: Reasonable and Prudent Measures.

Stewart & Jasper Orchards, et al., ("Stewart & Jasper") allege that FWS's failure to consider the economic impacts of implementing the reasonable and prudent measures ("RPMs") is arbitrary and capricious. Doc. 551 at 68 n. 24. Whenever FWS offers reasonable and prudent alternatives to avoid jeopardy to a species, it must also specify "those reasonable and prudent measures that [FWS] considers necessary or appropriate to minimize" incidental taking of the species. 16 U.S.C. § 1536(b)(4)(C)(ii). Stewart & Jasper argues that by formulating RPMs that it believes "are necessary and appropriate to minimize the effect of the proposed action on the delta smelt," without "provid[ing] a statement that allows for Reclamation to take into consideration the economic impacts of implementing the RPMs," *see* BiOp at 294, FWS has allegedly "arbitrarily left open the question of whether the RPMs are in fact reasonable, necessary, and [\*\*270] appropriate in light of the harm that their implementation will cause." Doc. 551 at 68 n. 24.

This argument is unsupported in law. Unlike 50 C.F.R. § 402.02's definition of a RPA, which provides that RPAs must be "economically and technologically" feasible, [\*\*958] the regulatory definition of RPM lacks such language:

Reasonable and prudent measures refer to those actions the Director believes necessary or appropriate to minimize the im-

pacts, i.e., amount or extent, of incidental take.

50 C.F.R. § 402.02. Even if the definition of RPM included an economic feasibility requirement, this language does not require that FWS "balance the benefit to the species against the economic and technical burden on the industry before approving an RPA," because such a conclusion is inconsistent with the purposes of the ESA under *TVA v. Hill. Greenpeace*, 55 F. Supp. 2d at 1267. Stewart & Jasper's motion for summary judgment regarding the lawfulness of the RPMs for failure to consider economic effects is DENIED; Federal Defendants and Defendant-Intervenors' cross-motions are GRANTED.

D. Stewart & Jasper, et al.'s, Argument that FWS Illegally Arrogated Authority to Itself Over Bureau of Reclamation and California [\*\*271] Department of Water Resources Operations.

The Stewart & Jasper Plaintiffs raise a novel argument that FWS "illegally arrogated" authority to itself over Reclamation and DWR, by "claim[ing] the ability to oversee [Project operations] indefinitely," rather than "advis[ing] Reclamation and DWR on how to avoid jeopardizing the delta smelt and destroying or adversely modifying its critical habitat." Doc. 551 at 80:

In RPA Component 1, for example, FWS not only set forth actions "designed to reduce the delta smelt entrainment losses," but also stated that "[t]hroughout the implementation of RPA Component 1, FWS will make the final determination as to OMR flows required to protect delta smelt." BiOp at 280-81. Likewise, in RPA Component 2 that FWS "shall make the final determination regarding specific OMR flows," BiOp at 282, as well as the FWS' reasonable and prudent measures. *See* BiOp at 294 (noting that FWS "shall have the final decision on the operations of the Permanent Gates" and that the members of the Gate Operations Review Team "can provide suggestions to operate the gates, but the ultimate decision on how to operate the gates to protect delta smelt will be made by the Service").

*Id.*

Stewart [\*\*272] & Jasper argue that this is unlawful because the ESA "does not give the FWS the power to

order other agencies to comply with their requests or to veto their decisions." *Id.* (citing *Sierra Club v. Marsh*, 816 F.2d 1376, 1386 (9th Cir. 1987)). The law is clear that FWS has no such authority, nor can FWS, as consulting agency, act *ultra vires* to usurp the operational authority of the Bureau and DWR over the Projects. The November 13, 2009 Decision found: "the action agency retains the ultimate responsibility for deciding whether, and how, to proceed with the proposed action after Section 7 consultation." Doc. 399, Mem. Decision re Cross-Motions for Summary Judgment on NEPA Issues, at 23-24 n.7. Even if FWS issues an RPA with specific requirements following a jeopardy or adverse modification finding, the action agency remains free to disregard such requirements, and FWS has no enforcement authority absent an ESA violation. Reclamation and DWR have provisionally adopted the RPA and have implemented many of its Actions, but the record does not show FWS employees have "claimed the ability to oversee these agencies indefinitely." Doc. 551 at 80.

[\*959] Stewart & Jasper's contention that FWS's reserved [\*\*273] to itself "an ongoing power of oversight, as well as a power to dictate new and different pumping restrictions," assumes that neither Reclamation, as action agency, nor DWR, as co-operator, have the ability to not comply with the RPA. Doc. 697 at 87. Reclamation is not legally compelled to blindly follow FWS's pronouncements. Reclamation retains the authority to reject the RPA at any time, subject to its obligation to reinstate consultation. Although FWS has not yet demonstrated a willingness or capability to protect interests other than the species, it cannot be assumed that Reclamation will not lawfully discharge its statutory water supply responsibilities.

Stewart & Jasper's motion for summary judgment regarding FWS's alleged unlawful arrogation of authority is DENIED; Federal Defendants and Defendant-Intervenors' cross-motions are GRANTED.

#### E. Information Quality Act Claim.

Family Farm Alliance ("FFA") Plaintiffs claim that Federal Defendants did not apply the IQA and its implementing guidelines in preparing and disseminating the BiOp.

##### (1) Legal Framework of the IQA.

The IQA provides in its entirety:

(a) IN GENERAL.--The Director of the Office of Management and Budget shall, by not later [\*\*274] than September 30, 2001, and with public and Federal agency involvement, issue guidelines under *sec-*

*tions 3504(d)(1) and 3516 of title 44, United States Code*, that provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies in fulfillment of the purposes and provisions of chapter 35 of title 44, United States Code, commonly referred to as the Paperwork Reduction Act.

(b) CONTENT OF GUIDELINES.--  
The guidelines under subsection (a) shall--

(1) apply to the sharing by Federal agencies of, and access to, information disseminated by Federal agencies; and

(2) require that each Federal agency to which the guidelines apply--

(A) issue guidelines ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by the agency, by not later than 1 year after the date of issuance of the guidelines under subsection (a);

(B) establish administrative mechanisms allowing af-

affected persons to seek and obtain correction of information maintained and disseminated by the agency that does  
[\*\*275] not comply with the guidelines issued under subsection (a); and

(C) report periodically to the Director--

(i) the number and nature of complaints received by the agency regarding the accuracy of information disseminated by the agency; and

(ii) how such complaints were handled by the agency.

tion" disseminated by federal [\*960] agencies. *See* Pub. L. No. 106-554, § 515(a) (2000). The statute itself contains no substantive provisions regarding information quality, leaving the structure and design of any such requirements to OMB. There is no relevant legislative history disclosing substantive Congressional intent regarding information quality.

Within one year of OMB's issuance of Guidelines, each federal agency was required to issue its own guidelines consistent with OMB's. *Id.* at § 515(b)(2)(A). OMB, the Department of the Interior, and FWS timely issued the required guidelines. *See, e.g., Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies*, 67 *Fed. Reg.* 8,452 (Feb. 22, 2002) [\*\*276] ("OMB IQA Guidelines"); *Information Quality Guidelines of the U.S. Department of the Interior*, 67 *Fed. Reg.* 50,687 (Aug. 5, 2002)) ("DOI IQA Guidelines"); FWS Information Quality Guidelines ("FWS IQA Guidelines")<sup>48</sup>. The IQA specifically required agencies to "establish administrative mechanisms allowing affected persons to seek and obtain correction of information maintained and disseminated by the agency...." and to "report periodically" on "the number and nature of complaints received by the agency regarding the accuracy of information disseminated by the agency" and "how such complaints were handled by the agency." *Id.* at § 515(b)(2)(B)&(C)(emphasis added).

48 Available at <http://www.fws.gov/informationquality/topics/IQAguidelines-final82307.pdf> (last visited August 11, 2010).

FWS's own IQA Guidelines are specific to its activities and disseminations, including biological opinions, and state that in order to ensure objectivity of information disseminated, the information will be presented in an "accurate[]," "clear[]," "complete[]," and "unbiased" manner. FWS IQA Guidelines III-8. In addition, FWS' IQA Guidelines require that a "preparer of a highly influential assessment or of influential [\*\*277] information ... document the strengths and weaknesses of the data underlying the assessment/information so that the reader will understand the context for the FWS decision." *Id.* at § VI-10. Plaintiffs maintain that FWS failed to comply with these guidelines because the "effects of the BiOp were assumed, not supported by data and objective and scientific analyses." Doc. 551 at 82.

(2) Right to Judicial Review Under the APA.

Federal Defendants and Defendant Intervenors raise a threshold objection, arguing that there is no right of judicial review under the IQA.

Pub. L. 106-554, 114 Stat 2763, 2763A-153-2763A-154 (2000) (codified at 44 *U.S.C.* § 3516).

Subsection (a) mandates that the Office of Management and Budget ("OMB") issue, by no later than September 30, 2001, government-wide guidelines to ensure the "quality, objectivity, utility, and integrity of informa-

It is undisputed that the IQA provides no private right of action. A party challenging an administrative agency's compliance with a substantive statute that lacks an internal private right of action must seek judicial review under the APA. *See Lujan v. Nat'l Wildlife Fed'n*, 497 U.S. 871, 882, 110 S. Ct. 3177, 111 L. Ed. 2d 695 (1990); *Village of False Pass v. Clark*, 733 F.2d 605, 609 (9th Cir. 1984) (because ESA contains no internal standard of review, APA § 706 governs review of actions brought under the ESA).

The APA authorizes suit by a plaintiff "suffering legal wrong because of agency action, or adversely affected or aggrieved by agency action within the meaning [\*\*278] of a relevant statute." 5 U.S.C. § 702. There is a presumption of reviewability under the APA. *Shalala v. Illinois Council on Long Term Care, Inc.*, 529 U.S. 1, 44 n.11, 120 S. Ct. 1084, 146 L. Ed. 2d 1 (2000). However, [\*\*961] the APA expressly precludes judicial review where: (1) any statute "precludes judicial review"; or (2) "agency action is committed to agency discretion by law." 5 U.S.C. § 701(a). If either of these exceptions applies, the lawsuit cannot proceed under the APA.

If neither exception applies, the APA permits judicial review of "[a]gency action made reviewable by statute and final agency action for which there is no other adequate remedy in a court...." 5 U.S.C. § 704. Where a statute lacks an internal judicial review provision, the "agency action made reviewable by statute" language is inapplicable, requiring the existence of a "final agency action." "Agency action" is defined to include "the whole or a part of an agency rule, order, license, sanction, relief, or the equivalent or denial thereof, or failure to act." 5 U.S.C. § 551(13). The APA requires that the agency action be upheld unless it is found to be "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law," or "without [\*\*279] observance of procedure required by law." 5 U.S.C. § 706(2).

a. APA § 702(a) (2)'s Exception for Agency Action "Committed to Agency Discretion by Law" Bars Judicial Review in this Case.

FFA does not allege that any statute expressly precludes judicial review of FFA's IQA claim. The issue is whether the IQA and/or its implementing guidelines, by law, commit to agency discretion the disputed agency actions challenged by Plaintiff's claim.

The general test for when an action is "committed to agency discretion by law" under the APA is whether there is "no law to apply." *Heckler v. Chaney*, 470 U.S. 821, 830, 105 S. Ct. 1649, 84 L. Ed. 2d 714 (1985) (internal quotation marks omitted). "Agency action is committed to the discretion of the agency by law when 'the statute is drawn so that a court would have no meaning-

ful standard against which to judge the agency's exercise of discretion.'" *Steenholdt v. FAA*, 314 F.3d 633, 638, 354 U.S. App. D.C. 192 (D.C. Cir. 2003) (quoting *Heckler*, 470 U.S. at 830). "If no 'judicially manageable standard' exists by which to judge the agency's action, meaningful judicial review is impossible and the courts are without jurisdiction to review that action." *Id.* Here, the IQA itself contains absolutely no substantive standards, [\*\*280] let alone any standards relevant to the claims brought in this case concerning the timing of responses to Requests and Appeals and the makeup of peer review panels. The statute itself commits the challenged agency actions to the agency's discretion.

However, even "[w]here an action is committed to absolute agency discretion by law, ... courts have assumed the power to review allegations that an agency exceeded its legal authority, acted unconstitutionally, or failed to follow its own regulations." *United States v. Carpenter*, 526 F.3d 1237, 1242 (9th Cir. 2008); *see also Padula v. Webster*, 822 F.2d 97, 100, 261 U.S. App. D.C. 365 (9th Cir. 1987) ("Judicially manageable standards may be found in formal and informal policy statements and regulations as well as in statutes, but if a court examines all these possible sources and concludes that there is, in fact, 'no law to apply,' judicial review will be precluded.") (quoting *Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 410, 91 S. Ct. 814, 28 L. Ed. 2d 136 (1971)). The critical issue is: Do the agency's own regulations create meaningful standards or do they preserve the discretion afforded by the statute?

*Salt Institute v. Thompson*, 345 F. Supp. 2d 589 (E.D. Va. 2004), *aff'd sub* [\*\*281] *nom.* on alternate grounds, *Salt Inst. v. Leavitt*, 440 F.3d 156 (4th Cir. 2006), applied 701(a)(2) and *Steenholdt* to the [\*\*962] IQA, finding that "[n]either the IQA nor the OMB Guidelines provide judicially manageable standards that would allow meaningful judicial review to determine whether an agency properly exercised its discretion in deciding a request to correct a prior communication." With respect to the request for correction at issue in *Salt Institute*:

[T]he guidelines provide that "[a]gencies, in making their determination of whether or not to correct information, may reject claims made in bad faith or without justification, and are required to undertake only the degree of correction that they conclude is appropriate for the nature and timeliness of the information involved." 67 Fed. Reg. at 8458. Courts have determined that regulations containing similar language granted sufficient discretion to agencies to preclude judicial

review under the APA. *See Steenholdt, 314 F.3d at 638* (holding that agency's decision under a regulation allowing an agency to take an action "for any reason the Administration considers appropriate" is committed to agency discretion and not reviewable under APA). [\*\*282] Judicial review of [the agency's] discretionary decisions is not available under the APA because the IQA and OMB guidelines at issue insulate the agency's determinations of when correction of information contained in informal agency statements is warranted.

*Id. at 602-603.* Do the IQA Guidelines create meaningful standards regarding the content of a biological opinion, or do the Guidelines preserve agency discretion over these procedural matters? <sup>49</sup>

49 Plaintiffs attempt to distinguish the many cases that have found no right to judicial review under the IQA on the ground none of them involved "final agency action" cognizable under the APA, which provides for judicial review of a "final agency action for which there is no other adequate remedy in a court ...." 5 U.S.C. § 704. Plaintiffs are correct that the relevant cases do not concern "final agency actions," for purposes of the APA. For example, *Salt Institute* involved the issuance of information about a trial study, an action the district court found was not "a final agency action necessary for judicial review under the APA." 345 F. Supp. 2d at 602. Here, the issuance of the BiOp is indisputably final agency action. However, "final agency [\*\*283] action" is a necessary but not sufficient prerequisite to judicial review under the APA. Judicial review may also be precluded where there is no "judicially manageable standard" by which to judge the agency's action. *Heckler v. Chaney*, 470 U.S. at 830.

Plaintiffs' attempt to distinguish *Salt Institute* on the ground that, in preparing and disseminating "highly influential" scientific documents, the agency is mandated to follow a scientific approach to develop the best available scientific data used in that document. Specifically, Plaintiffs reference FWS IQA Guidelines VI-10, which provide:

VI -- 10 How will FWS describe the strengths and weaknesses of the data used

in influential scientific information and highly influential scientific assessments

The preparer of a highly influential assessment or of influential information will document the strengths and weaknesses of the data underlying the assessment/information so that the reader will understand the context for the FWS decision. The narrative will be contained in the administrative record of the issue under consideration. The documentation may be done in a narrative that includes a complete literature cited section, and an assessment [\*\*284] of the strengths and weaknesses of the information used for advising the decision at hand. The narrative's form and length is left to the preparer. The following [\*963] bullet points provide questions to consider in the narrative.

- o What types of research studies does the assessment/information rely upon (e.g. experimental studies with controls, statistically designed observational studies that test hypotheses, monitoring studies, information synthesis, professional judgment etc.)?

- o How recent is the research?

- o What are the sources for the underlying data that support the assessment/information (e.g. peer reviewed article reporting primary data or data synthesis, unpublished peer reviewed reports, on-line publication, textbook, personal communication etc.)?

- o Which of the sources were most crucial to the conclusions reached in the assessment/information?

- o What type of review did each source receive (anonymous independent peer review, external peer review, agency review,

public review and comment etc.)?

o Were the reviewers independent of the FWS? Were the reviewers independent of individuals or groups advocating a certain course of action by FWS?

o Were the reviews in compliance with OMB M-05- [\*\*285] 03, "Final Information Quality Bulletin for Peer Review"?

Two examples of how one might provide such a characterization are provided below:

Example 1: (A number of references are listed.) These references were the primary sources of data that provided the basis for the decision. They are peer reviewed studies with an experimental design that includes controls and testable hypotheses. They were completed within the last 5 years and were independently reviewed by non-FWS personnel and published in scientific journals.

Example 2: (A number of references are listed.) These references were articles and sources of data that provided specific data points that were included in the decision document, but by themselves did not primarily contribute to the decision. These citations are a combination of fact sheets, summaries of information, professional judgments, and personal communications that have not been peer reviewed. Most of the data is current (within the last 7 years).

Although this biological opinion is undoubtedly the type of "influential document" <sup>50</sup> to which this provision applies, Plaintiffs' overreach by suggesting that these guidelines require the agency to follow any particular scientific [\*\*286] approach to the development of the best available scientific data used in a BiOp. All that this guideline affirmatively requires is that the agency prepare some kind of "narrative" that documents the strengths and weaknesses of the data upon which the document relies. There are no other "judicially manageable standards" included in this guideline.

50 The FWS IQA Guidelines further state that the term "influential, when used in the phrase 'influential scientific, financial, or statistical information,' means that [FWS] can reasonably determine that dissemination of the information will have or does have a clear and substantial impact on important public policy or private sector decisions, and thus, a decision or action to be taken by the Director.... As a general rule, FWS considers an impact clear and substantial when a specific piece of information or body of information is a principal basis for a FWS position." FWS IQA Guidelines, § III-10.

[\*964] Under this guideline provision, Plaintiffs have not claimed that no such narrative was prepared. <sup>51</sup> But, that is not the thrust of any of the IQA claims in this case, which seek to impose substantive standards on the presentation, use, and analysis [\*\*287] of data by FWS. None of the guidelines cited by Plaintiffs set forth any "judicially manageable standards" against which the presentation, use, or analysis of data can be measured. The FWS guidelines disclaim any intent to do so or any right to judicial review. There is no right to judicial review of Plaintiffs' IQA claims. FFA's motion for summary judgment is DENIED. Federal Defendants' cross motion is GRANTED.

51 Whether such a claim would be subject to judicial review is not clear. The guidelines specify that they are "intended only to improve the internal management of FWS relating to the [IQA]. Nothing in these guidelines is intended to create any right or benefit, substantive or procedural, enforceable by law or equity against the United States, its agencies, its offices, or another person. These guidelines do not provide, in any by themselves, any right to judicial review." FWS IQA Guidelines Part IV.

(3) To the Extent FFA Bases Any of its Claims against Reclamation on the ESA, Such Claims are Subject to the ESA's Pre-Filing Requirements.

To the extent FFA's IQA and ESA claims overlap, its ESA claims are subject to the ESA's pre-filing notice requirement. No suit may be commenced [\*\*288] under the ESA "prior to sixty days after written notice of the violation has been given to the Secretary." 16 U.S.C. § 1540(g)(2)(A)(i). This requirement is jurisdictional and "[a] failure to strictly comply with the notice requirement acts as an absolute bar to bringing suit under the ESA." *Southwest Ctr. for Biological Diversity*, 143 F.3d at 520. Failure to comply with a statutory notice requirement is a jurisdictional objection that may be addressed "at any time." *See Fed. R. Civ. P. 12(h)(3)*.

Here, FFA failed to notify Reclamation of its intent to sue. Plaintiffs argue that "[a]doption of a BiOp is a final agency action, and such actions are subject to judicial review under the APA," citing *Bennett v. Spear*, 520 U.S. at 178. However, allowing a plaintiff to circumvent the ESA's 60-day notice requirement by claiming that its cause of action arises under the APA would circumvent the ESA's notice requirement entirely. *Hawaii County Green Party v. Clinton*, 124 F. Supp. 2d 1173, 1193 (D. Haw. 2000).

To the extent that FFA's claims against Reclamation arise under the ESA, their motion for summary judgment is DENIED on the ground that they failed to comply with the statutory notice requirement. [\*\*289] Federal Defendants' and Defendant Intervenors' cross-motions are GRANTED.

#### F. Renewed Claim That FWS Violated NEPA.

Plaintiffs attempt to revisit the issue of whether FWS violated NEPA in issuing the BiOp and its RPA. Plaintiffs first renew an argument that was rejected in the Salmonid Consolidated cases, namely that *Ramsey v. Kantor*, 96 F.3d 434 (9th Cir. 1996), the only case in which the issuance of a biological opinion was found to violate NEPA, controls here. In *Ramsey*, the NEPA obligation was imposed on the consulting agency's issuance of a biological opinion in part because there was no federal action agency to comply with NEPA.

The November 12, 2009 NEPA decision in this case found *Ramsey* inapplicable because the action agency is Reclamation. *See* Doc. 399 at 16-17. [\*965] Plaintiffs argue that the Courts' initial finding was incorrect because, here, as in *Ramsey*, the BiOp was not only imposed upon Reclamation's operations, but also upon the operations of DWR, a state agency. This argument was rejected in the Consolidated Salmonid Cases shortly after the cross-motions in the Consolidated Smelt Cases were

filed. The March 5, 2010 Consolidated Salmonid Cases decision concluded:

Plaintiffs [\*\*290] ignore the interconnected nature of the SWP and CVP projects. Reclamation and DWR have, for many years, operated the projects in a coordinated manner. *See* OCAP Biological Assessment ("OCAP BA") at 1-2. The Biological Assessment ("BA"), prepared by Reclamation, describes the project for which consultation was being sought as "the ongoing operations of the CVP and SWP and potential future actions that are foreseeable to occur within the period covered by the project description." *Id.* at 1-1. The two water projects, which are jointly operated by Reclamation and DWR, share water resources, storage, pumping, and conveyance facilities to manage and deliver one third of the water supply for the State of California. Reclamation's BA provided NMFS with extensive analyses of the effects of coordinated operation of the CVP and SWP on the Listed Species.

*Consolidated Salmonid Cases*, 1:09-cv-1053 OWW DLB, Doc. 266 at 14 (emphasis in original). Plaintiffs offer no new law or persuasive authority compelling a finding of clear error to justify reconsideration.

Alternatively, Plaintiffs argue that "FWS's future choices with respect to OMR flows restrictions are 'major federal actions' within the scope [\*\*291] of [NEPA's implementing regulations]." Doc. 551 at 87. This argument continues:

[R]ather than DWR or Reclamation operating the CVP and SWP, respectively, the BiOp and its RPA have resulted in transferring operational control to FWS for up to six months year (i.e., December through June). FWS' future choices with regard to implementation of RPA Components 1 and 2 will cause distinct and separate impacts to the human environment within both the CVP and SWP service areas. Even if Reclamation shares a NEPA obligation with regard to its acceptance of the BiOp, Reclamation is not the proper federal agency to account for and analyze the environmental effects of FWS' actions that will occur within the SWP

service area. These SWP impacts are solely attributable to the FWS' formulation of the RPA and its ongoing role in implementing that RPA, and they were not caused by Reclamation and are beyond Reclamation's discretion or jurisdiction. FWS will continue to make weekly water use and resource allocation decisions that amount to major federal actions significantly affecting the human environment in both CVP and SWP service areas without the benefit of the information required by a proper NEPA [\*\*292] review and without satisfying the public disclosure and accountability purposes of NEPA.

*Id.*

This is an attempt to re-argue and re-frame arguments previously decided. The prior NEPA rulings determined that Reclamation bears the NEPA responsibility in this case as action agency. "Reclamation proposed the action (in the form of the Operations and Criteria Plan ('OCAP')) to FWS, which triggered the preparation of the BiOp." Doc. 399 at 28. "Reclamation was not xbound' by the BiOp until it chose to proceed with the OCAP and implement the RPA. Once Reclamation did so, operation of the Projects [\*966] became the relevant agency 'action,' and Reclamation, as action agency, is the more appropriate lead agency under NEPA." *Id.* at 30. Reclamation accepted the adaptive management protocol prescribed in the RPA "as a constraint upon its operations when it provisionally accepted the RPA." Doc. 399 at 30. FWS's day-to-day decisions to implement the adaptive management protocol are a natural incident of Reclamation's decision to adopt the RPA. Moreover, FWS's setting of specific OMR flows under RPA Components 1 and 2 is based on a weekly review of salvage data, distribution, flow and turbidity levels, population [\*\*293] status, and other information, making NEPA review of such actions impractical. *See Flint Ridge Dev. Co. v. Scenic Rivers Ass'n*, 426 U.S. 776, 788-89, 96 S. Ct. 2430, 49 L. Ed. 2d 205 (1976) (provision in applicable law requiring statement of record to become effective 30 days after filing made preparation of EIS "inconceivable"); *Kandra*, 145 F. Supp. 2d at 1205 (finding that "[a]n EIS takes at least several months to complete"). FWS has no legal or functional authority to operate the projects and adequate remedies exist to compel the Bureau to stop FWS, if FWS endeavors to do so.

Plaintiffs' motion for summary judgment as to FWS's liability under NEPA is DENIED; Federal Defen-

dants' and Defendant-Intervenors' cross motion is GRANTED.

#### G. Reclamation's Liability under the ESA.

Following the issuance of a biological opinion, the ESA regulations require the action agency, here, Reclamation, to "determine whether and in what manner to proceed with the action in light of its section 7 obligations and the Service's biological opinion." 50 C.F.R. § 402.15(a). In making that determination, a federal action agency "may not rely solely on a FWS biological opinion to establish conclusively its compliance with its substantive obligations [\*\*294] under section 7(a)(2)." *Pyramid Lake Paiute Tribe of Indians v. U.S. Dept. of Navy*, 898 F.2d 1410, 1415 (9th Cir. 1990). In *City of Tacoma v. Fed. Energy Regulatory Comm'n*, 460 F.3d 53, 76, 373 U.S. App. D.C. 117 (D.C. Cir. 2006), the D.C. Circuit summarized the caselaw culminating in *Pyramid Lake*:

[The] interagency consultation process reflects Congress's awareness that expert agencies (such as the [NMFS] and [FWS]) are far more knowledgeable than other federal agencies about the precise conditions that pose a threat to listed species, and that those expert agencies are in the best position to make discretionary factual determinations about whether a proposed agency action will create a problem for a listed species and what measures might be appropriate to protect the species. Congress's recognition of this expertise suggests that Congress intended the action agency to defer, at least to some extent, to the determinations of the consultant agency, a point the Supreme Court recognized in *Bennett v. Spear*, 520 U.S. 154, 169-170, 117 S. Ct. 1154, 137 L. Ed. 2d 281 (1997). In *Bennett*, the Court stated that an action agency disregards a jeopardy finding in a BiOp "at its own peril" and bears the burden of articulating the reasons for reaching its [\*\*295] contrary conclusion. *Id.*

Accordingly, when we are reviewing the decision of an action agency to rely on a BiOp, the focus of our review is quite different than when we are reviewing a BiOp directly. In the former case, the critical question is whether the action agency's reliance was arbitrary and capricious, not whether the BiOp itself is somehow flawed. *Aluminum Co. of Am. v. Adm'r, Bonneville Power Admin.* [\*967] ,

175 F.3d 1156, 1160 (9th Cir.1999); *Pyramid Lake Palute Tribe v. U.S. Dep't of Navy*, 898 F.2d 1410, 1415 (9th Cir.1990); *Stop H-3 Ass'n v. Dole*, 740 F.2d 1442, 1460 (9th Cir.1984); cf. *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 422 F.3d 782, 790 (9th Cir. 2005) (direct review of a BiOp). Of course, the two inquiries overlap to some extent, because reliance on a facially flawed BiOp would likely be arbitrary and capricious, but the action agency "need not undertake a separate, independent analysis" of the issues addressed in the BiOp. *Aluminum Co.*, 175 F.3d at 1161. In fact, if the law required the action agency to undertake an independent analysis, then the expertise of the consultant agency would be seriously undermined. Yet the action agency must not blindly adopt [\*\*296] the conclusions of the consultant agency, citing that agency's expertise. *Id.* Rather, the ultimate responsibility for compliance with the ESA falls on the action agency. 16 U.S.C. § 1536(a)(1)-(2). In *Pyramid Lake*, the Ninth Circuit balanced these two somewhat inconsistent principles and articulated the following rule:

[E]ven when the [consultant agency's] opinion is based on "admittedly weak" information, another agency's reliance on that opinion will satisfy its obligations under the Act if a challenging party can point to no "new" information—i.e., information the [consultant agency] did not take into account—which challenges the opinion's conclusions.

898 F.2d at 1415; see also *Defenders of Wildlife v. U.S. EPA*, 420 F.3d 946, 959, 976 (9th Cir. 2005); *Stop H-3 Ass'n*, 740 F.2d at 1459-60.

*City of Tacoma*, 460 F.3d at 75-76. The D.C. Circuit rejected the City of Tacoma's claim that the consultant agency in that case, FERC, was liable under the ESA

because the City had not "presented FERC with new information that was unavailable to [NMFS] or [FWS] and that would give FERC a basis for doubting the expert conclusions in the BiOps those agencies prepared." *Id.* at 76.

Here, Plaintiffs attempt [\*\*297] to side-step this standard, arguing that Reclamation should have independently recognized and addressed specified errors in the BiOp. For example, they argue Reclamation should have recognized the error caused by comparing CALSIM data to non-CALSIM Data because Reclamation had extensively analyzed the use of CALSIM in the BA. See AR 010698-010807. The BA stated:

The simulation results of the OCAP BA are designed for a comparative evaluation because the CALSIM-II model uses generalized rules to operate the CVP and SWP systems and the results are a gross estimate that may not reflect how actual operations would occur.... Results should only be used as a comparative evaluation to reflect how changes in facilities and operations may affect the CVP-SWP system.

AR 010701. FWS took this information into account in the BiOp. See BiOp at 204-206, reviewing Calsim II modeling performed in the BA. Plaintiffs have not demonstrated that Reclamation was in possession of any "new information" not considered by FWS that provided Reclamation a basis for questioning the BiOp's expert conclusions. Absent such a showing, even though the BiOp is flawed in many ways, Reclamation could rely upon it without [\*\*298] incurring ESA liability.

## VIII. CONCLUSION

It cannot be disputed that the law entitles the delta smelt to ESA protection. It is significant that the co-operator of the Projects, DWR, in its endeavors to protect [\*968] a substantial part of the State's water supply, opposes as unjustified and based on bad science some of the RPA Actions. It is equally significant that despite the harm visited on California water users, FWS has failed to provide lawful explanations for the apparent over-appropriation of project water supplies for species protection. In view of the legislative failure to provide the means to assure an adequate water supply for both the humans and the species dependent on the Delta, the public cannot afford sloppy science and uni-directional prescriptions that ignore California's water needs. A court is bound by the law. Resource allocation and establishing legislative priorities protecting the environment are the

prerogatives of other branches of government. The law alone cannot afford protection to all the competing interests at stake in these cases.

For all the reasons set forth above:

(A) Plaintiffs' and DWR's motions for summary judgment that the BiOp violates the ESA and the [\*\*299] APA are GRANTED IN PART AND DENIED IN PART; and Federal Defendants' and Defendant Intervenors' cross-motions are GRANTED IN PART AND DENIED IN PART based on the following findings:

(1) It was not arbitrary, capricious, or clear error for FWS to base its jeopardy conclusion in part on Kimmerer (2008)'s predictions of relative increases in delta smelt entrainment.

(2) FWS's failure to apply a quantitative life-cycle model to evaluate the impacts of Project operations on the smelt did not violate the ESA.

(3) The BiOp's reliance on analyses using raw salvage figures to set the upper and lower OMR flow limits of Actions 1, 2, and 3 was arbitrary and capricious and represents a failure to use the best available science. Actions 1, 2, and 3 depend so heavily on these flawed analyses that this failure is not harmless. Remand is necessary.

(4) Comparison of Calsim II to Dayflow model runs created potentially material bias in the BiOp's evaluation of the impacts of Project operations on the position of X2 and related conclusions regarding population dynamics and habitat. FWS's failure to address or explain this material bias repre-

sents a failure to consider and evaluate a relevant factor and violates [\*\*300] the ESA and APA. Remand is required.

(5) The use of Dayflow to represent the baseline did not improperly attribute past effects to the Projects.

(6) The flawed Calsim II to Dayflow comparison fatally taints the justification provided for Action 4. Remand is required.

(7) Plaintiffs' argument that Action 4 is unlawful because it is an "untested hypothesis" is an unfounded interpretation of the scientific method.

(8) FWS's reliance on Feyrer (2007), Feyrer (2008), and Bennett (2005) was not arbitrary, capricious, or clear error.

(9) The best science available at the time the BiOp issued supports the conclusion that X2 is a valid surrogate for delta smelt habitat.

(10) Plaintiffs' argument that FWS violated the best available science standard because the smelt are not habitat limited is unfounded. The BiOp admits the delta smelt may not be habitat limited, but reasonably concludes that the species has become increasingly habitat limited over time, contributing to the population's decline, and that worsening habitat conditions may limit smelt recovery.

[\*969] (11) FWS's use of a linear stock-recruit model, although scientifically criticized, was not ar-

bitrary, capricious, or clear error.

(12) The BiOp [\*\*301] has failed to sufficiently explain why maintaining X2 at 74 km (following wet years) and 81 km (following above normal years), respectively, as opposed to any other specific location, is essential to avoid jeopardy and/or adverse modification. Remand is required.

(13) Federal Defendants' reliance on turbidity as one of several triggers for Action 1 was not arbitrary, capricious, or clear error.

(14) Plaintiffs' argument that FWS violated the ESA and/or the APA by excluding data from 2007 in its analysis of entrainment effects, but including it in its calculation of the ITL is without merit. FWS offered a reasonable explanation for these choices.

(15) The BiOp provides a reasonable explanation for why the 2006-2008 year range was used to calculate the adult delta smelt ITL, but unlawfully fails to explain why 2005 was added to the juvenile ITL calculation. Remand is required.

(16) The BiOp also fails to explain why FWS chose to set the ITL based on the average cumulative salvage index for the years selected. FWS shall explain this choice on remand.

(17) In general, the BiOp's conclusions about the causal connections between Project Operations

and "other stressors" are ambiguous. However, [\*\*302] the BiOp's assertion that Project Operations contribute to and/or exacerbate the impacts on delta smelt of predation, aquatic macrophytes, and microcystis are unsupported by record evidence and/or explanation. Remand is required.

(18) The record does not support the BiOp's conclusion that food web and pollutants/contaminant impacts are indirect effects of Project operations. Remand is required.

(19) Plaintiffs' omnibus challenge to the substance of the critical habitat analysis fails. However, the critical habitat analysis does not specifically explain its conclusion that Project operations are reasonably certain to exacerbate the impact of contaminants to delta smelt habitat. In addition, because critical habitat conclusion 3(c) explicitly relies upon the flawed analysis regarding the movement of X2, this conclusion is without support in the record and is arbitrary and capricious. Remand is required.

(20) Although there is record support for the BiOp's conclusion that Project operations are likely to jeopardize the continued existence and/or adversely modify the critical habitat of the delta smelt, the analyses supporting the specific flow prescriptions set forth in the RPA are fatally [\*\*303] flawed and predominantly unsupported.

The BiOp does not justify or explain its attribution to Project operations adverse impacts caused by others stressors. When combined, the totality of these failures demand remand to the agency for further consideration and explanation.

(B) Plaintiffs' motion for summary judgment that the BiOp does not segregate discretionary from nondiscretionary actions is DENIED; Federal Defendants' and Defendant-Intervenors' cross motions are GRANTED.

(C) Plaintiffs' motion for summary judgment that the BiOp does not undertake the analysis required by 50 C.F.R. § 402.02 is GRANTED; Federal Defendants' and Defendant-Intervenors' cross [\*970] motions are DENIED. The BiOp completely fails to analyze economic feasibility, consistency with the purpose of the action, and consistency with the action agency's authority demanded by § 402.02. Further analysis in compliance with § 402.02 is required on remand.

(D) Plaintiffs' motion for summary judgment that FWS did not address comments on the draft BiOp is DENIED; Federal Defendants' and Defendant-Intervenors' cross motions are GRANTED.

(E) Stewart & Jasper's motion for summary judgment that the BiOp failed to consider the economic [\*\*304] impacts of promulgating the RPMs is DENIED; Federal Defendants' and Defendant-Intervenors' cross motions are GRANTED.

(F) Stewart & Jasper's motion for summary judgment that FWS illegally arrogated authority to itself over Reclamation and DWR is DENIED; Federal Defendants' and Defendant-Intervenors' cross motions are GRANTED.

(G) Family Farm Alliance's motion for summary judgment on its IQA claim is DENIED; Federal Defendants' and Defendant-Intervenors' cross motions are GRANTED.

(H) Plaintiffs' renewed motion for summary judgment that FWS violated NEPA is DENIED; Federal Defendants' and Defendant-Intervenors' cross motions are GRANTED.

(I) Plaintiffs' motion for summary judgment that Reclamation violated the ESA is DENIED; Federal Defendants' and Defendant-Intervenors' cross motions are GRANTED.

The 2008 BiOp and its RPA are arbitrary, capricious, and unlawful, and are remanded to FWS for further consideration in accordance with this decision and the requirements of law. Plaintiffs shall submit a form of order consistent with this memorandum decision within five (5) days of electronic service.

A status conference is set for January 4, 2011, at 12:00 noon, in Courtroom 3 (OWW), to address [\*\*305] any need for further proceedings.

SO ORDERED

Dated: December 14, 2010

/s/ Oliver W. Wanger

Oliver W. Wanger

United States District Judge

## **APPENDIX DOC. 9**



## **NEWS FOR IMMEDIATE RELEASE**

**August 15, 2012**

**Contact:**

Ted Thomas, Information Officer

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### **Researchers Shake Delta Soil to Better Understand Earthquake Risk**

**SACRAMENTO** -- Researchers will simulate the shaking of an earthquake on a remote part of Sherman Island today to better understand how the unique peat soil of the Sacramento-San Joaquin Delta may respond to a seismic event.

The engineering researchers from the University of California, Los Angeles conducted a similar shaking test last year on dry peat soil. This year, their test will monitor the response of saturated peat soil.

"We hope to learn how the peaty organic Delta soil will contribute to seismic levee performance," said Scott Brandenburg, Vice Chair of the UCLA Civil and Environmental Engineering Department and leader of the research team. "We already know that liquefaction of inorganic sandy soils is an important problem in the Delta, but we don't know as much about the peat."

The research promises to inform an important debate over how much risk earthquakes pose to the Delta's levees -- and thus the state and federal water supply systems that are centered in the Delta.

Using heavy equipment in a cow pasture owned by the California Department of Water Resources, the UCLA engineers built a six-foot-high, 40-foot-wide, 12-foot-long model of a levee. The model levee was reinforced to transmit the shaking into the ground where the motions will be sampled. The researchers attached a mobile field shaker to the model levee crest. Their model levee is unsaturated and built of

non-liquefiable materials, unlike the saturated, liquefiable fills in many Delta levees. Their focus is not whether the newly-created embankment fails during shaking. Instead, they seek to understand how the underlying peat soil of Sherman Island responds to the earthquake simulation. Such highly-organic soil serves as the foundation for many of the roughly 1,100 miles of levees across the Delta.

Once a region of tule marsh and tidal wetlands, the Delta of today is a patchwork of islands ringed by levees and separated by waterways. The highly-organic Delta soil, built by thousands of years of decomposing tules, may be as deep as 80 feet, but it oxidizes and disappears easily when dried and tilled. As a result, some Delta islands are bowl-like, dipping as much as 25 feet below sea level.

Though they appear as ordinary farm fields, the Delta islands are critical to protecting infrastructure important to the entire California economy. They serve as barriers that help protect the fresh river water that supplies much of the state from the saltwater that could encroach from San Francisco Bay if the islands were not there. If several Delta levees failed in an earthquake, river water would be sucked into the sunken islands. The flow of freshwater out toward the Bay would diminish, allowing saltwater to be drawn deeper into the Delta and make its way toward the large pumps in the south Delta that supply two major water projects. Federal and state water project operators would be forced to shut down the pumps to prevent saltwater contamination of aqueducts, pumps, and treatment plants. Such a shutdown could interrupt deliveries of water to Southern California, the Central Valley, and the Santa Clara Valley. If the interruption lasted long enough, it could cause billions of dollars of damage to the state's economy.

In the roughly 160 years since people began scraping together levees in the Delta, levee failures have caused island flooding at least 140 times. Though none of the failures have been linked to an earthquake, the record is too brief, geologically, to accurately gauge the seismic hazard to the Delta's levee system.

Several large faults, including the Hayward, Calaveras, and San Andreas faults, lie to the west of the Delta. But smaller local faults that run through the Delta present the most significant seismic hazard to levees, including the western Tracy and southern Midland faults.

According to the 2009 Delta Risk Management Strategy prepared by the Department of Water Resources, a ground motion equivalent to less than 20 percent of the acceleration of gravity would be capable of collapsing, or liquefying, the loose, sandy soils in many Delta levees. An earthquake capable of generating such motion has a 45 percent chance of being exceeded in the western Delta in the next 30 years, according to experts. The hazard decreases farther from the Bay; experts put the probability at 26 percent in the eastern Delta. However, the hazard increases each year that passes without an earthquake.

"The Department of Water Resources welcomes this research that will help us to better understand the vulnerability of the Delta levees and the water supply to earthquakes," said David Mraz, chief of DWR's Delta levees and environmental

engineering branch. "In the meantime, the state will continue to work with our local partners to make improvements to the levees in the regions that protect communities, farms, wildlife habitat, and critical infrastructure."

The state has invested approximately \$300 million in Delta levee improvements since 2005, when Hurricane Katrina overwhelmed Louisiana's flood defenses.

There are few places in the world with such extensive levees on peat soils as the Delta. Scientists hope to learn from measurements recorded during Wednesday's experiment whether saturated peat soil will settle in response to earthquake shaking. Laboratory tests performed on peat samples indicate that the peat will expel water following shaking, which could result in levee settlement after an earthquake. However, this mechanism has never been observed in the field, and the Sherman Island test will provide that opportunity and help scientists interpret their laboratory results for application to Delta levees.

The Delta is also unusual in that the underlying soil -- peat -- is typically softer than the mixture of sand, silt, clay, peat and other types of materials scraped together to construct levees. By testing the response of peat soils to ground acceleration, researchers will get a better sense of how energy transfers between the peat soils and levee materials. The experiment may help better determine the magnitude of earthquake that could trigger collapse, or liquefaction, of Delta levees.

The research team, including geotechnical engineers Jonathan Stewart of UCLA and Robb Moss of California Polytechnic State University, performed a similar test on Sherman Island in August 2011. At that time, the peat soil beneath the artificial embankment was dry to a depth of six feet and the embankment settled very little upon shaking. Researchers speculate that the fibrous peat soil may be stiffer, stronger, and more resistant to seismic energy when dry than when wet.

For Wednesday's experiment, the researchers built a berm around the experiment site in order to soak the underlying peat to the soil surface. The saturation will mimic the condition of the peat beneath the Delta levees. (Many Delta levees essentially act as dams and are kept wet year-round by the waterways they channel.)

Various instruments arrayed within 300 feet of the test site will measure ground motion and water pressure. Previous tests have shown that the ground motion generated by UCLA's mobile field shaker dissipates before it reaches the levees that protect Sherman Island.

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*The Department of Water Resources operates and maintains the State Water Project, provides dam safety and flood control and inspection services, assists local water districts in water management and water conservation planning, and plans for future statewide water needs.*

## **APPENDIX DOC. 10**

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## Losses of Sacramento River Chinook Salmon and Delta Smelt to Entrainment in Water Diversions in the Sacramento-San Joaquin Delta

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### ABSTRACT

Pumping at the water export facilities in the southern Sacramento-San Joaquin Delta kills fish at and near the associated fish-salvage facilities. Correlative analyses of salvage counts with population indices have failed to provide quantitative estimates of the magnitude of this mortality. I estimated the proportional losses of Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*) and delta smelt (*Hypomesus transpacificus*) to place these losses in a population context. The estimate for salmon was based on recoveries of tagged smolts released in the upper Sacramento River basin, and recovered at the fish-salvage facilities in the south Delta and in a trawling program in the western Delta. The proportion of fish salvaged increased with export flow, with a mean value around 10% at the highest export flows recorded. Mortality was around 10% if pre-salvage losses were about 80%, but this value is nearly unconstrained. Losses of adult delta smelt in winter and young delta smelt in spring were estimated from salvage data (adults) corrected for estimated pre-salvage survival, or from trawl data in the southern Delta (young). These losses were divided by population size and accumulated over the respective seasons. Losses of adult delta smelt were 1–50% (medi-

an 15%), although the highest value may have been biased upward. Daily losses of larvae and juveniles were 0–8%, and seasonal losses accumulated were 0–25% (median 13%). The effect of these losses on population abundance was obscured by subsequent 50-fold variability in survival from summer to fall.

### KEYWORDS

Chinook salmon *Oncorhynchus tshawytscha*, delta smelt *Hypomesus transpacificus*, diversions, population ecology

### SUGGESTED CITATION

Kimmerer, Wim J. 2008. Losses of Sacramento River Chinook Salmon and Delta Smelt (*Hypomesus transpacificus*) to Entrainment in Water Diversions in the Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science. Vol. 6, Issue 2 (June), Article 2.

### INTRODUCTION

One of the greatest challenges facing resource managers is assessing the effectiveness of their actions in influencing ecosystems or biological populations. This difficulty arises from three sources: 1) weak or

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inaccurate understanding of the causal links between actions and responses; 2) inability to control for other sources of variability; and 3) inherent inaccuracy in monitoring causal and response variables. Yet, managers are held accountable for successes and failures, as we have witnessed recently with the decline of pelagic organisms in the upper San Francisco Estuary (Sommer et al. 2008). Thus, the challenge for the scientific community is how to detect and quantify effects of management actions in the absence of strong correlative relationships between these actions and the response variables. This requires an analysis of mechanisms rather than one based on correlative relationships alone.

The San Francisco Estuary is a highly altered and managed system (Nichols et al. 1986) in which conflicts over resources are particularly strong. Perhaps the greatest conflict is due to the diversion and export of substantial quantities of freshwater from the tidal freshwater reach in the Sacramento-San Joaquin Delta. Losses of fish to mortality associated with export pumping have been blamed in part for declines of numerous species including striped bass (Stevens et al. 1985), Chinook salmon (Kjelson and Brandes 1989), and delta smelt (Bennett 2005). Nevertheless, no quantitative estimates have been made of the population-level consequences of losses to the export facilities of any fish species. Kimmerer et al. (2001) concluded that large proportional losses to the export facilities were a minor contributor to variability in the striped bass population of the Estuary. Jassby et al. (2002) conducted a mass balance of chlorophyll concentration in the Delta and concluded that losses of phytoplankton to export pumping must be large, but were masked in correlative analyses by other sources of variation. Similar calculations have not been made for other taxonomic groups, and there have been no published reports of correlations between any measure of export losses and subsequent population size.

Despite the lack of evidence for population-level effects, a strong influence of the south Delta export facilities on populations of estuarine and anadromous fish has been assumed for several reasons. First, large numbers of fish are entrained in the fish facilities (Brown et al. 1996). Second, it is reasonable to expect

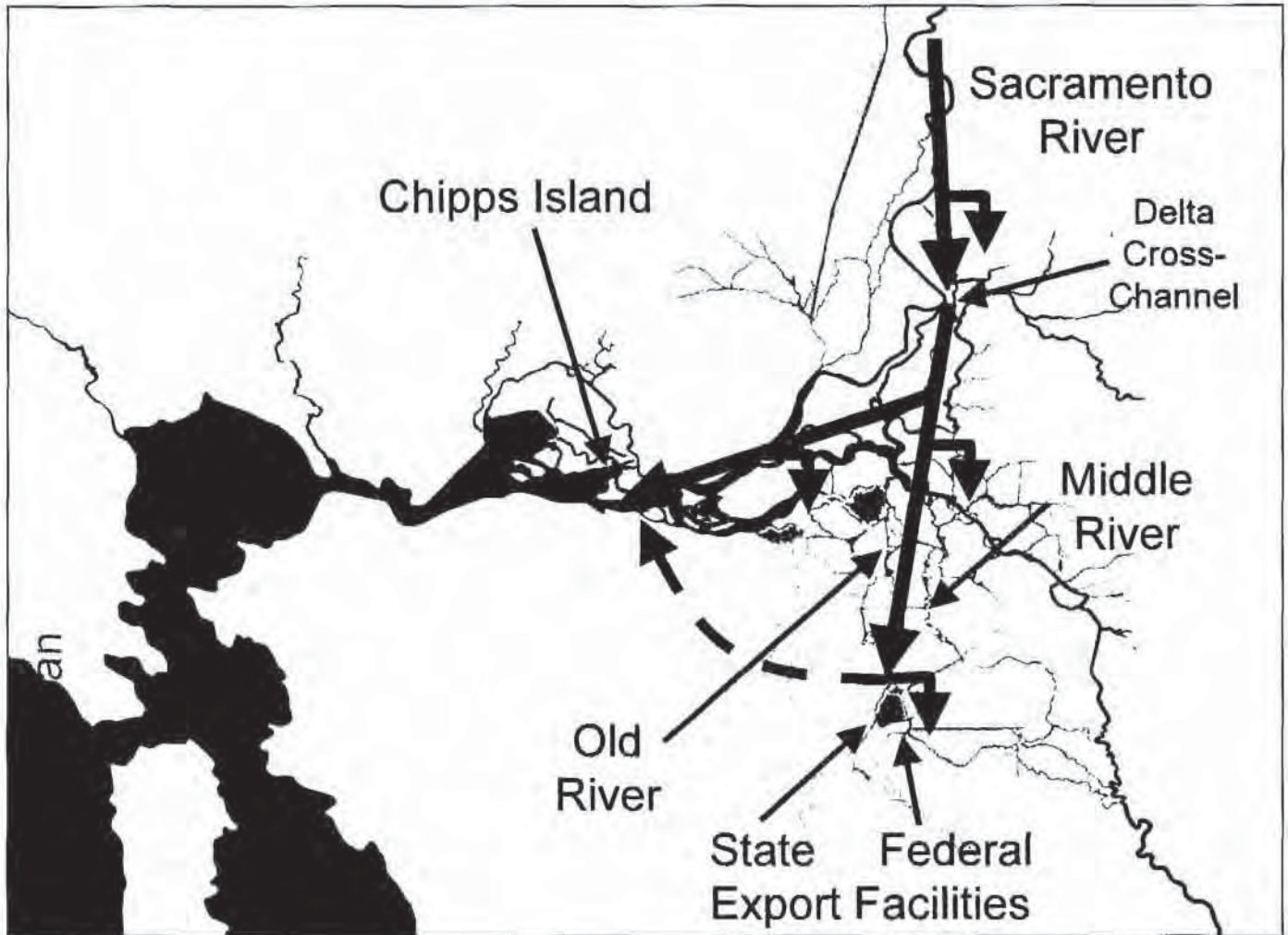
a large effect on some fish because of the large quantities of water exported, at times more than half of the inflow to the Delta (Kimmerer 2004). Third, manipulations of flow patterns in the Delta provide the only apparent tool for managing some fish populations such as delta smelt.

In this paper I estimate the effects of export pumping in terms of proportional losses of two fish species. Chinook salmon (*Oncorhynchus tshawytscha*) and the threatened delta smelt (*Hypomesus transpacificus*) are target taxa for restoration and management in the Delta. Data for several races of Chinook salmon are available to estimate the losses of these fish to direct effects of entrainment. I focus on winter Chinook because it has been the target of considerable restoration effort, although data for other races are used to provide greater resolution. Two life stages of delta smelt are examined: adults in late winter, and larvae and juveniles in spring. Effects of export pumping are estimated mechanistically, rather than through correlative analyses with the respective population abundances.

The conceptual framework for these calculations differs for the two species. Young Chinook salmon are exposed to export effects during movement through the Delta. Data on length distributions at the export facilities and in field studies suggest that juvenile Chinook generally are exposed to entrainment only during movement, and are rarely entrained while rearing. Young Chinook rear in or migrate through the Delta at various times of year but are most abundant in the Delta from March through June (Williams 2006). Although most of the migrating fish are small fall-run Chinook, winter Chinook and other runs form a substantial pulse of fish larger than the fall run in February–March (Williams 2006). Chinook smolts may take any of several pathways that lead them through the Delta either to the export facilities or through the western margin of the Delta at Chipps Island, and then to sea (Figure 1). When control gates in the Delta Cross-Channel (Figure 1) are open, the smolts may enter the central Delta further upstream, and this could increase their probability of entrainment in the export facilities.

Delta smelt are considered to be resident fish but are actually weakly anadromous, spending most of their

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**Figure 1.** Map of the San Francisco Estuary showing locations mentioned in the text. Green arrows indicate general movement pathways for winter Chinook salmon; the dashed arrow represents movement of salvaged fish by truck. Red arrows indicate mortality losses; only those occurring at the export facilities are accounted for here.

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lives in brackish water where they are not exposed to export entrainment (Bennett 2005). The adults spawn in freshwater in late winter, and those in the southern Delta are then vulnerable to entrainment at the export facilities. Eggs are demersal and therefore invulnerable to entrainment, but the pelagic larvae and juveniles in the southern Delta are vulnerable from the time they hatch until they move seaward into brackish water. Thus, export pumping causes a continuous mortality that acts on the population over time during two life stages.

### Fish Facility Operations

Fish facilities associated with the state and federal water export facilities (Figure 1) are designed to salvage fish from the water and return them to the Estuary (Brown et al. 1996; Haefner and Bowen 2002). These facilities use two sets of louvers to concentrate the fish behaviorally, but this process is not very efficient. For example, many salmon and other fish are lost to predation in the waterways leading to the fish facilities (Gingras 1997). The efficiency with which the louvers concentrate the fish can be  $\ll 100\%$  (Bowen et al. 2004). In addition, few delta smelt probably survive the salvage process (Bennett 2005).

The salvage facilities accumulate fish in holding tanks during sampling periods that are most often 2 hours but have ranged from 10 minutes to 9 hours during 1995–2006. During each sampling period, a sub-sample may be taken over a shorter time-period, nominally 20 minutes (state facility) or 10 minutes (federal facility) although it may be longer or shorter. Karp et al. (1997) compared the sub-sampling procedure for the federal facility with complete analysis of the salvaged fish, validating this procedure. All fish  $> 20$  mm in a sub-sample are counted and identified, and salmon marked with clipped adipose fins are inspected for coded-wire tags and, if present, the tags are read.

It is helpful to define terms (see Table 1 for symbols). Daily *salvage* is the number of fish of given characteristics (species, stage, length) estimated to have entered a fish facility in a day. Daily *entrainment* is

the estimated net number of fish that arrived at the entrance to the fish facility per day, i.e., those that arrived and did not leave the area except via the fish facilities. Entrainment exceeds salvage because of mortality in the waterways, leading to the export facilities and losses through the louvers. Daily *loss* is the estimated number entrained that were not subsequently salvaged and returned alive to the Estuary, which includes losses both before and after the salvage process; these are also termed “direct” losses because they are directly attributable to pumping operations.

Losses of fish due to altered hydrodynamic conditions or migration cues in the Delta are called “indirect” losses. Although export pumping has substantial impacts on flow patterns in the Delta, the extent to which such alterations affect survival of fish is much less clear. Indirect losses may be important (NMFS 2004), but they remain hypothetical and unquantified, and are not calculated in this paper.

## METHODS

Daily salvage (see Table 1 for all symbols used in this paper) is calculated from the counts taken during each sampling period as:

$$\hat{N}_{di} = \sum_{p=1}^{P_d} \frac{N_{dpi} M_{dpi}}{m_{dpi}} \quad (1)$$

where hats indicate estimated quantities. For tagged Chinook salmon (see below), salvage counts were available only for the entire day, so Equation 1 was simplified by summing over all time-periods within each day:

$$\hat{N}_{di} = \frac{\sum_{p=1}^{P_d} N_{dpi} \sum_{p=1}^{P_d} M_{dpi}}{\sum_{p=1}^{P_d} m_{dpi}} \quad (2)$$

Equations 1 and 2 were compared using salvage data for total Chinook salmon from 1995–2006. The mean ratio of estimates from Equation 2 to those from Equation 1 for all samples with total daily counts  $> 100$  was  $0.98 \pm 0.017$  (95% CL,  $N = 219$ ), so these equations were considered equivalent for tagged

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**Table 1.** Definition of terms used in the models for Chinook salmon (C) and delta smelt (D). Terms are unitless unless stated. Subscripts may be added to indicate export facilities (i, state = 1, federal = 2, combined = x), cohorts (j), surveys (s), sampling time-periods for calculating salvage (p), or calendar time-periods (d, mo).

Term	Species	Definition
A	D	Total abundance of fish = $D_s V$
$A_{L,t}$	D	Abundance of fish of length L at time t
D	CD	Duration of the sampling period (days)
$D_s$	D	Mean density over all samples ( $m^{-3}$ )
$E_i$	CD	Louver efficiency of facility i
$E_k$	D	Efficiency of Kodiak trawl
$E_L$	D	Relative efficiency of the 20-mm net as a logistic function of length of fish
g	D	Growth rate ( $mm\ d^{-1}$ )
H	D	Number of fish hatching per day
L	D	Length of fish (mm)
m	D	Daily mortality rate ( $d^{-1}$ )
$m_n$	D	Daily natural mortality rate (i.e., not due to direct export effects) ( $d^{-1}$ )
$M_{dpi}$	CD	Duration of fish salvage period p (min) on day d
$m_{dpi}$	CD	Duration of subsampling during salvage period p (min) on day d
$N_{dpc}$	C	Number of fish counted during Chipps Island trawl p on day d
$N_{dpi}$	CD	Number of fish counted at facility i during period p on day d
$N_{di}$	CD	Daily salvage for facility i ( $d^{-1}$ )
$N_i$	CD	Total salvage for facility i
$N_{Ri}$	C	Daily number of fish successfully released from fish facility i ( $d^{-1}$ )
$N_{SD}$	D	Total fish caught in trawl samples in the south Delta during a survey
$N_{w\delta}$	C	Five-day running mean of total fish caught centered on day $\delta$ (weighting factor)
$P_d$	C	Total number of samples on day d (fish facilities or Chipps Island)
$P_s$	C	Proportional salvage of fish leaving Delta
$P_L$	CD	Proportional loss of fish to export effects
$Q_{SD}$	D	Daily flow to the south Delta (= Old and Middle River flow) ( $m^3 d^{-1}$ )
S	D	Survival (fraction); subscripts indicate time-period or cohort j
$S_{HT}$	C	Fraction of fish surviving handling and trucking
$S_{pi}$	CD	Fraction of fish entrained that reach louvers
$S_{Si}$	C	Fraction of fish entrained that enter salvage facility
t	D	Any day between $T_0$ and the final date of the simulation (d)
$T_0$	D	Initial hatch date (d)
$T_j$	D	Initial hatch date (d) for cohort j
$T_I$	D	Final hatch date (d)
$T_f$	D	Final day of survey
u	C	Migration speed, $m\ d^{-1}$
V	D	Volume of habitat over which trawl catches are averaged ( $m^3$ )
$V_{dpc}$	C	Volume sampled by sample p on day d in the Chipps Island Trawl ( $m^3$ )
$V_{SD}$	D	Total volume filtered in survey s at South Delta stations ( $m^3$ )
W	C	Width of channel at Chipps Island (~ 1,000 m)
Z	C	Depth over which salmon are assumed to migrate (4 m)
$\theta$	D	Efficiency ratio, a free parameter in adult loss equation (18)
$\lambda$	C	Ratio of loss to salvage, calculated from pre-salvage survival
$\Lambda_{di}, \Lambda_i$	D	Daily or cumulative loss to export facilities
$\Phi_{di}, \Phi_i$	CD	Daily or cumulative entrainment to export facilities
$\Phi_{dc}, \Phi_c$	CD	Daily or cumulative flux of fish past Chipps Island

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Chinook salmon. For either method, the total salvage for a sampling period  $D$  is:

$$\hat{N}_i = \sum_{d=1}^D \hat{N}_{di} \quad (3)$$

Entrainment is calculated as:

$$\hat{\Phi}_{di} = \frac{\hat{N}_{di}}{S_{pi} E_i} \quad (4)$$

and daily total loss is:

$$\hat{\Lambda}_{di} = \hat{\Phi}_{di} - \hat{N}_{ri} = \hat{N}_{di} \left( \frac{1}{S_{pi} E_i} - S_{HT} \right) \quad (5)$$

$\Lambda = \Phi$  for delta smelt since they are assumed not to survive salvage. Proportional loss is calculated differently for salmon and for adult and young delta smelt (below).

Flow data were obtained from the Dayflow accounting program (Jassby et al. 1995; see <http://iep.water.ca.gov/dayflow>). Net flows in Old and Middle Rivers (Figure 1) have been determined by the U.S. Geological Survey since 1987 (Ruhl and Simpson 2005; Ruhl et al. 2006; P. Smith, USGS, pers. comm.).  $X_2$ , or the distance up the axis of the Estuary to where the tidally-averaged near-bottom salinity is 2 psu, was determined from daily Delta outflow as described in Jassby et al. (1995). Data on salmon-tagging studies and trawl data were obtained from the Interagency Ecological Program's Bay Delta and Tributaries Project (BDAT) website (<http://bdat.ca.gov/>). Salvage data for all species, sample data and abundance indices for delta smelt, and zooplankton abundance data were obtained from the California Department of Fish and Game (K. Fleming, R. Gartz, K. Hieb, and K. Souza, pers. comm.). Zooplankton biomass was determined from abundance data (Kimmerer 2006).

## Chinook Salmon

Migrating salmon suffer a one-time risk of entrainment, in that fish that survive through the Delta either arrive at the export facilities and are entrained,

or migrate past Chipps Island and presumably become invulnerable to entrainment. Salmon that arrive at the export facilities and are successfully salvaged also pass Chipps Island on their way to sea, and are vulnerable to capture there.

The general approach was to use recapture rates of coded-wire-tagged (CWT) hatchery smolts released in or near the upper Sacramento River and recaptured in the Delta fish facilities or at Chipps Island. The number of fish recaptured at each location was used to calculate salvage and losses at the fish facilities and flux of fish past Chipps Island, which were accumulated over the season and then used to calculate proportional salvage and loss.

The Livingstone Stone National Fish Hatchery (LSNFH) on the upper Sacramento River has released winter Chinook smolts marked with CWT and clipped adipose fins each spring since 1998. The Coleman National Fish Hatchery (CNFH) has released tagged fall and late-fall Chinook smolts each spring since 1981. Tagged fish have been released in groups of 81 to approximately 300,000 with unique tag codes, and up to 14 separate tag codes with up to approximately one million fish have been released on a single date. Tagged fish are recaptured at various locations, and data are stored in the BDAT database. I estimated the flux of tagged fish past Chipps Island and the losses to the fish facilities for years starting with brood-year 1998.

The following assumptions were made throughout this analysis:

1. The proportional loss of CWT hatchery fish represents that of naturally-spawned Chinook salmon.
2. Mortality factors at the fish facilities are constant in time and with export flow.
3. Fish are randomly distributed in time and across the Chipps Island channel in the top 4 meters, and migrate equally by day or night at a constant speed unaffected by flow.
4. Sampling at Chipps Island and at the fish facilities is unbiased, and the net is 100% efficient.
5. All CWT fish caught have their tags read.

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Assumption 1 is fundamental to this approach as well as to numerous other studies (e.g., Newman and Rice 2002), but at present is untestable. Possible biases introduced by the other assumptions are discussed below.

Each year, CWT smolts in several tag groups have been released on a single day (Table 2). LSNFH winter Chinook have been released between January 27 and February 5, except that fish were released on April 9 in 1998. CNFH Chinook have been released in November through April, with one release in July 2005 which was not used in this analysis. I treated all groups of fish released on a single day as a single release; recaptures were too few to estimate variability among groups within single days.

Parameter values in Equation 5 were previously established for regulatory purposes (NMFS 2004). A series of experiments with marked juvenile Chinook salmon was used to estimate the pre-screen proportional loss for the state facility ( $1 - S_{p1}$ ), which had a mean of 85% and range of 63–99% (Gingras 1997). The regulatory value is 75% (NMFS 2004). The pre-screen loss term for the federal facility has been set at 15% without any justification other than that the federal facility lacks the large forebay (Clifton Court) leading to the state facility, which may enhance predation on fish arriving at the facility. Studies conducted when the louvers were installed (Skinner 1973) gave a louver efficiency  $E_l$  of ~ 90%, although more recent data suggest lower louver efficiency: Karp et al. (1995) reported overall efficiency of 50% at the federal facility with substantial variation, and Bowen et al. (2004) reported 85% efficiency for the secondary louvers at the federal facility. Handling and trucking loss terms ( $1 - S_{HT}$ ) together amount to 4%. Given the high uncertainty about the pre-screen loss and louver efficiency, and the low rate of loss due to handling and trucking, I simplified Equation 5 by setting  $S_{HT} = 1$  for both facilities, and assuming the same pre-salvage survival term  $S_s$  for both facilities, combining both pre-screen mortality and loss through the screens:

$$\hat{\Lambda}_i = \left( \frac{1}{S_s} - 1 \right) \hat{N}_i = \lambda \hat{N}_i \quad (6)$$

Tagged fish are captured by the U.S. Fish and Wildlife Service (USFWS) Chipps Island trawl survey, which takes 10–20 trawl samples daily in spring and less often during other seasons (Brandes and McLain 2001). The number of tagged fish collected by the Chipps Island trawl during each survey was extrapolated to a “fish flux” from the mean catch per volume and the migration speed past Chipps Island. The midwater trawl net is 4.6 meters deep and 9.1 meters wide (Brandes and McLain 2001), and the volume sampled is based on readings of a flowmeter in the net mouth. Fish were caught at the fish facilities slightly more often by night than by day (data from 1996–2004, 39% of all salmon and 49% of the samples were by day), which could be due to higher predation rates during daylight, so we are justified in assuming roughly equal passage at Chipps Island by day and night.

The fish flux past Chipps Island for each day on which a survey was conducted was calculated as:

$$\hat{\Phi}_{dc} = \frac{\sum_{p=1}^{P_d} N_{dpc}}{\sum_{p=1}^{P_d} V_{dpc}} WZu, \quad (7)$$

which is the fish per unit volume multiplied by cross-sectional area and migration speed. Previous analyses have used the time spent sampling to provide a time-scale for migration (Brandes and McLain 2001), but that approach does not account for the migration speed of the fish, and is appropriate only for a stationary sampler. Migration speed  $u$  in Equation 7 was estimated at about 6 km/d based on the median date of recapture of tagged late-fall Chinook released at Ryde on the Sacramento River and caught at Chipps Island (Brandes and McLain 2001; Newman 2003). The fish flux was calculated for each day when a survey was conducted, and values were interpolated for days with no survey, then summed over the period between the first and last days when fish were captured:

$$\hat{\Phi}_c = \sum_{d=1}^D \hat{\Phi}_{cd}. \quad (8)$$

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**Table 2.** Chinook salmon. Summary of data from mark-recapture studies. Source is Coleman National Fish Hatchery (C) or Livingstone Stone National Fish Hatchery (L). LSNFH fish were all winter Chinook; Coleman fish were fall, late-fall, or spring Chinook. Dates are for the brood year if later than October, or for the next year if in January–June.

Source	Brood Year	Release Date	Recapture Dates		Length at Release (mm)	Number Released	Catch		
			Initial	Final			Chippis Is.	SWP	CVP
C	1997	11/10	11/26	03/09	118	66316	22	2	0
C	1997	12/09	12/19	03/16	134	66244	34	11	5
C	1997	01/12	01/18	03/18	137	61048	26	0	1
C	1997	01/13	01/19	03/16	141	63100	63	0	0
C	1997	01/14	01/20	03/16	137	67408	54	0	3
C	1997	01/22	01/27	03/18	138	57046	31	0	3
C	1997	03/04	03/25	05/15	56	27628	34	0	0
C	1997	03/06	03/27	05/11	59	35122	23	0	0
C	1997	03/31	04/16	05/22	64	37067	162	0	0
C	1997	04/07	04/19	05/29	65	33392	87	0	0
C	1997	04/22	04/28	06/03	72	28585	336	0	0
C	1997	04/23	05/01	06/03	66	32007	53	0	0
C	1998	11/12	11/24	02/05	116	66119	32	1	0
C	1998	12/15	12/22	03/30	120	64546	48	2	1
C	1998	01/04	01/11	05/26	126	59032	110	5	1
C	1998	03/31	04/29	05/09	59	29869	3	1	0
C	1998	04/20	04/26	05/20	78	24239	158	7	0
C	1998	04/21	05/01	05/23	69	32464	37	0	0
C	1998	04/27	05/05	05/28	75	34513	133	3	2
C	1998	04/28	05/05	05/13	78	34037	28	0	0
C	1999	11/12	11/27	01/28	110	70500	6	2	1
C	1999	12/09	12/20	02/19	110	75948	16	8	3
C	1999	12/21	01/03	02/21	110	83383	9	6	0
C	1999	01/04	01/19	04/20	120	79868	53	63	28
C	1999	01/12	01/21	03/21	120	81680	14	8	6
C	1999	04/07	04/15	04/28	75	33820	50	1	0
C	1999	04/14	04/20	05/21	77	32504	258	2	0
C	1999	04/21	04/26	05/29	78	35228	256	0	0
C	2000	11/03	12/11	01/21	113	58050	6	1	2
C	2000	12/08	12/25	02/26	119	54568	0	5	1
C	2000	01/02	01/17	04/23	128	62127	53	51	18
C	2000	01/09	01/20	03/15	129	65284	11	9	4
C	2000	04/13	04/23	05/13	73	62634	186	0	1
C	2000	04/27	05/07	05/30	76	62325	217	2	0

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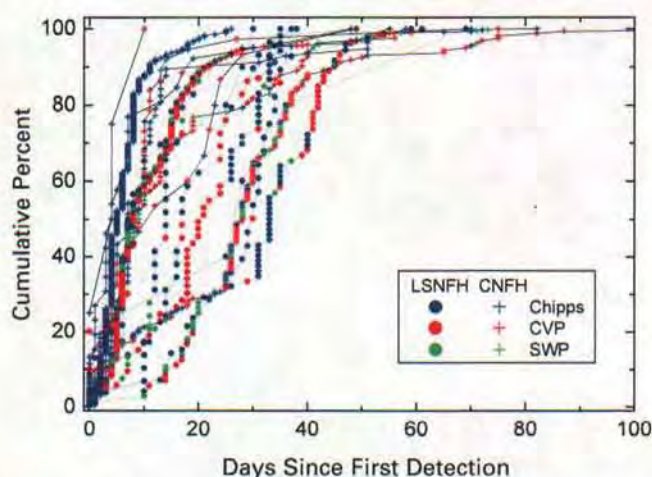
Source	Brood Year	Release Date	Recapture Dates		Length at Release (mm)	Number Released	Catch		
			Initial	Final			Chippis Is.	SWP	CVP
C	2001	11/14	11/28	04/27	120	88039	11	4	4
C	2001	12/12	12/21	03/01	120	73856	9	23	5
C	2001	01/04	01/10	03/08	135	65237	55	15	6
C	2001	01/08	01/14	04/23	120	77418	283	155	51
C	2001	04/18	04/25	05/27	77	79730	419	2	0
C	2001	04/25	05/03	05/29	77	71246	289	0	0
C	2002	11/08	12/06	01/06	102	67650	13	5	3
C	2002	12/02	12/18	05/01	117	59887	50	81	29
C	2002	01/02	01/08	03/31	125	66571	166	656	221
C	2002	01/15	01/22	03/21	131	74760	21	46	15
C	2003	11/28	12/11	02/27	126	65339	37	16	6
C	2003	12/31	01/08	04/06	130	72716	166	333	81
C	2003	01/02	01/08	03/24	127	69247	137	222	67
C	2003	01/30	02/11	03/17	146	64983	3	35	6
C	2003	04/16	04/24	05/14	79	75162	58	0	0
C	2004	11/05	12/10	01/03	121	87000	3	1	1
C	2004	11/29	12/14	01/31	117	69993	24	1	1
C	2004	01/04	01/11	03/03	134	32348	231	124	20
C	2004	01/13	01/27	02/27	134	69795	6	25	1
C	2005	12/02	12/12	02/10	116	80014	47	18	5
C	2005	01/03	01/08	03/22	141	82691	126	14	5
C	2005	01/19	01/27	03/06	141	65496	20	2	1
L	1998	01/28	03/15	04/19	70	10243	21	8	0
L	1999	01/27	02/22	05/01	80	1145	4	1	0
L	2000	02/01	03/05	04/04	80	4826	8	2	0
L	2001	01/30	03/07	05/07	80	62138	24	2	2
L	2002	01/30	02/14	04/14	82	8131	34	26	12
L	2003	02/05	02/20	04/09	88	11568	21	26	6
L	2004	02/03	02/22	03/31	87	8584	21	1	1
L	2005	02/02	02/17	03/27	86	15603	20	3	6

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All recaptured fish from each release group were included in estimates of fraction salvaged and lost at the export facilities. Smolts were recaptured over various time intervals, with occasional stragglers recaptured weeks to months later than others in the same group (Figure 2). A relationship was calculated between proportional salvage and export flow averaged over the migration period (see below), but averaging export flow evenly over the migration season would give excessive weight to the later period when few fish were migrating. I therefore calculated a weighted mean export flow during the migration season, using the total daily catch at the fish facilities and Chipps Island as the weighting factor. The total daily catch was first interpolated to fill in days with no survey, then smoothed using a 5-day running mean:

$$N_{w\delta} = \frac{\sum_{d=\delta-2}^{\delta+2} \sum_{p=1}^{p_d} (N_{dp1} + N_{dp2}) + N_{dc}}{5} \quad (9)$$

For each release group, I calculated total salvage and total losses (Equation 6) over the season as a proportion of the fish leaving the Delta. Proportional salvage  $P_s$  is unaffected by pre-salvage survival, where-



**Figure 2.** Chinook salmon. Examples of cumulative percent of coded-wire-tagged smolts captured at the fish facilities and at Chipps Island. All releases from LSNFH are shown, and a sample of 10 releases from CNFH. Each symbol represents an individual fish.

as proportional loss  $P_L$  is very sensitive to the magnitude of  $S_s$  (see below). The proportional salvage for the migration period is the ratio of total salvage to the sum of salvage and migration past Chipps Island:

$$\hat{P}_s = \frac{\hat{N}_1 + \hat{N}_2}{\hat{N}_1 + \hat{N}_2 + \Phi_c} \quad (10)$$

This proportion has a slight bias (<10%) because some fish are salvaged but not counted and subsequently pass Chipps Island. This calculation does not require knowledge of mortality patterns within the Delta or the details of alternative migration pathways. Proportional salvage was related to weighted export flow by a generalized linear model with a log link function and error distribution proportional to the mean (McCullagh and Nelder 1989). This model was fit for the combined data from the two hatcheries, including all data points with > 6 fish recaptured, and with source (hatchery) as a covariate. Additional covariates tried in this model were Sacramento River flow and position of Delta cross-channel gates (0 = both gates closed, 1 = both gates open), both weighted means over the migration season as described above for export flow.

Proportional loss is the total loss divided by the total number of fish departing the Delta either via loss at the export facilities or migration past Chipps Island:

$$\hat{P}_L = \frac{\hat{\Lambda}_1 + \hat{\Lambda}_2}{\hat{\Lambda}_1 + \hat{\Lambda}_2 + \Phi_c} = \frac{\lambda}{\lambda + \frac{1}{\hat{P}_s} - 1} \quad (11)$$

in which the bias due to double-counting is negligible. The difference in denominators of the left-hand term of Equation 11 and Equation 10 arises because pre-salvage mortality is not included in Equation 10. The principal sources of uncertainty in the calculations of proportional loss arise from great uncertainty about the pre-salvage survival of fish at the fish facilities, and the migration speed of the fish. Although the estimate of migration speed could be refined, the lack of resolution of the pre-salvage survival is the principal impediment to even estimating—much less reducing—the errors in the estimates of

proportional losses. I estimated  $\hat{P}_L$  as a function of export flow based on the fitted value of  $\hat{P}_S$  from the above relationship with export flow, and alternative assumed values of pre-salvage survival.

### Delta Smelt

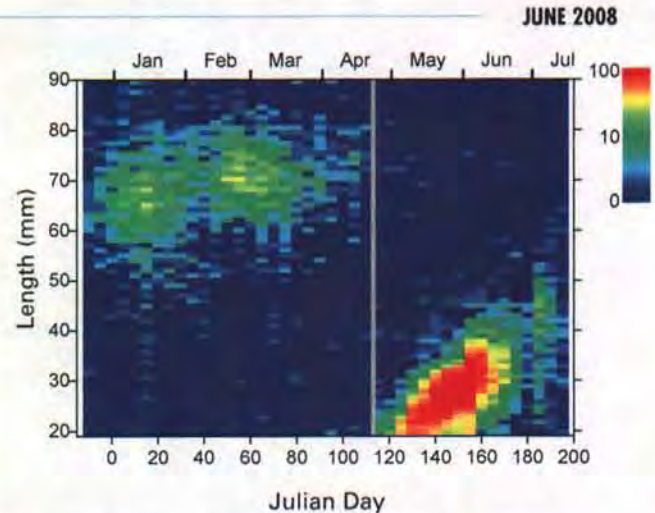
In contrast to the situation for salmon, the loss of delta smelt to entrainment can be considered a continuous mortality, for which a greatly simplified expression in the absence of natural mortality is:

$$P_L = 1 - \prod_{d=1}^D \left( 1 - \frac{\Lambda_x}{A} \right). \quad (12)$$

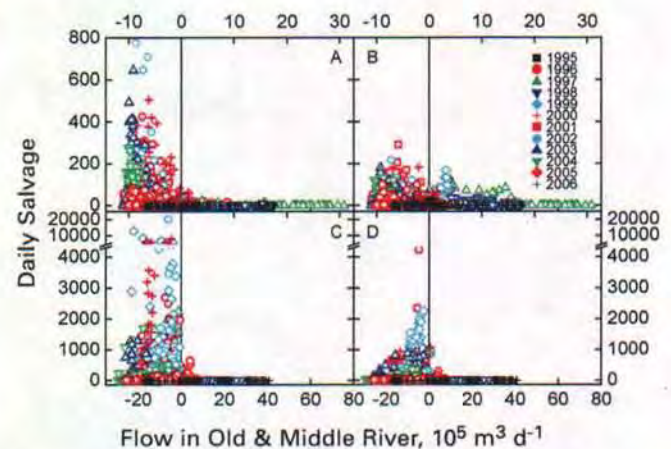
The product is calculated over the entire season of vulnerability.

Two groups of delta smelt are prominent in the salvage estimates from the fish facilities: adults from mid-December to mid-April, and larvae and juveniles from mid-April to mid-July (Figure 3). From approximately mid-July to mid-December, the fish are in brackish water, and few are salvaged in the fish facilities. I therefore focused on losses of adults and larvae/juveniles. Adults are also captured in the spring Kodiak trawl survey (Bennett 2005, see <http://www.delta.dfg.ca.gov/data/skt/>), and young fish are captured in the spring-summer 20-mm survey of late larvae and juveniles (Dege and Brown 2004, see <http://www.delta.dfg.ca.gov/data/20mm/>).

The general approach was to estimate entrainment as a mortality (since successful salvage is assumed to be negligible), and multiply the corresponding survival values for each day of exposure to entrainment (Equation 12). The sum of net flows in Old and Middle Rivers (Figure 1) was used to estimate the movement of fish toward the fish facilities. Net flow is southward toward the export facilities when export pumping is large compared to flow in the San Joaquin River. Salvage of adult and young delta smelt is usually low when this flow is positive, although substantial salvage of adult smelt occurred at the federal facility in some years of positive Old and Middle River flow (Figure 4).



**Figure 3.** Delta smelt. Combined salvage at south Delta fish facilities for 1997–2005. Image plot showing numbers of fish by length and day, according to log scale at right. Larger fish are adults, and small ones are larvae and juveniles, roughly separated by the vertical line. Larvae smaller than 20 mm are generally not counted. Very few fish were caught between July and mid-December.



**Figure 4.** Daily salvage of delta smelt at the fish facilities vs. flow in Old and Middle Rivers, positive northward, 1995–2006. (A) and (B) are adults; (C) and (D) are juveniles. (A) and (C) are for the state facility; (B) and (D) are for the federal facility.

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**Adults**

The general approach for adult delta smelt was to divide estimated daily entrainment by the monthly estimated population size from the Kodiak trawl survey to get a daily proportional loss rate, which was accumulated over each day in the month and each month in the season (December–April):

$$\hat{P}_l = 1 - \prod_{mo=12}^4 \prod_{d=1}^{d(mo)} \left( 1 - \frac{\Phi_{dx}}{A_{mo}} \right). \quad (13)$$

Natural mortality was not considered explicitly in this formulation because most of the losses occur early in the season before the population begins to decline. The principal difficulty with this method is that the fish flux is determined from the salvage sampling program, whereas the population size is determined from the Kodiak trawl data; thus, differences in efficiency between the two programs introduce an unknown parameter. I estimated this parameter as explained below by using Kodiak trawl data from stations in the southern Delta, where the fish are most vulnerable to entrainment.

Principal assumptions were:

1. The Kodiak trawl survey takes a representative sample of the adult delta smelt population.
2. Entrainment is proportional to the combined southward flow in Old and Middle Rivers.
3. All delta smelt entrained toward the export facilities are lost from the population.
4. The efficiency of sampling by the fish salvage facilities is constant.

The first assumption is unlikely to be true given the fixed stations of the Kodiak survey and the concentration of stations in some areas. An alternative approach is to calculate mean catch by sub-region, extrapolate to abundance by sub-region, and sum these values across sub-regions. Doing so results in only a small change in the calculated population size (e.g., see Kimmerer and Nobriga 2005). Assumption 2 is not strictly true since some adult delta smelt are reported from the salvage facilities even when flow is northward, probably because of dispersion (Figure 4A

and B). However, this relationship was applied only during times when flow was southward, when advection would have dominated the entrainment flux. Although adult smelt do not drift passively, the patterns in Figure 4A and B support the idea that entrainment is related to the southward flow toward the export facilities. Adult and juvenile delta smelt do not tolerate much handling, and most are probably killed in the salvage process (Bennett 2005). Assumption 4 is unlikely to be true, and violation of this assumption introduces error variance into the calculations.

The Kodiak trawl program has taken surveys from January–May since 2002 but only the three to four surveys using standard stations were included (surveys designated by single digits). Based on reported lengths, all fish appeared to be adults, except for those smaller than 60 mm in May. Catch per volume was calculated assuming a volume filtered of 6,223 m<sup>3</sup>, which is the median based on flowmeter readings and a mouth area of 12.5 m<sup>2</sup> (R. Baxter, California Department of Fish and Game, pers. comm.). The Kodiak trawl samples the upper ~ 2 meters of the water column, and adult delta smelt are most abundant in the upper half of the water column, ~ 4 meters. Population size throughout the habitat was calculated as the mean catch per m<sup>3</sup> multiplied by the volume of habitat shallower than 4 meters, about  $0.9 \times 10^9$  m<sup>3</sup>.

Data from the fish facilities included length for about 90% of the fish identified. Fewer than 1% of the fish caught and measured in May were adults—i.e., larger than 60 mm—so data from May were eliminated. About 40% of the fish measured in April were larger than 50 mm, and considered adults. This fraction was used to draw a random sample of the fish salvaged but not measured, which was added to salvage data for fish measured as > 50 mm in April. These fish, and all fish collected in December–March, were included in the analysis.

The daily proportional loss rate for both facilities is (from Equations 4 and 5, assuming no salvage is successful):

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$$\hat{P}_{1,d} = \frac{E_k(\hat{\Phi}_{d1} + \hat{\Phi}_{d2})}{\hat{D}_s V} = \frac{E_k \left( \frac{\hat{N}_{d1}}{S_{p1} E_1} + \frac{\hat{N}_{d2}}{S_{p2} E_2} \right)}{\hat{D}_s V} \quad (14)$$

The efficiency  $E_2$  for the federal facility is about 13% (M. Bowen, U.S. Bureau of Reclamation, pers. comm.). However, neither  $E_1$  nor the pre-screen survivals  $S_{p1}$  are known for delta smelt, nor is  $E_k$ . To simplify the analysis, I combined the two parameters into one for each facility, and assumed that the two resulting values scale as the mean catch at the two facilities. For adult delta smelt from 1995–2006, on days when both facilities had non-zero catches (a total of 235 days), the median ratio of the catch per volume at the state facility to that at the federal facility was 0.95, with 10th and 90th percentiles of 0.2 and 3.8. If fish were arriving at the two facilities in equal abundance per unit volume, the combined efficiency parameters are not consistently different between the two facilities. Therefore, Equation 14 was rearranged to give:

$$\hat{P}_{1,d} = \frac{\theta (\hat{N}_{d1} + \hat{N}_{d2})}{\hat{D}_s V}, \text{ where} \\ \theta = \frac{E_k}{E_1 S_{p1}} = \frac{E_k}{E_2 S_{p2}}. \quad (15)$$

Entrainment can also be estimated as the product of abundance per volume in the south Delta times flow in the south Delta, so:

$$\frac{N_{SD}}{V_{SD}} Q_{SD} = \theta (\hat{N}_{d1} + \hat{N}_{d2}). \quad (16)$$

The value of  $\theta$  was estimated using the Kodiak trawl catches from four south Delta stations (902, 906, 914, and 915). Data from 2006 were excluded because flow in Old and Middle Rivers was northward most of the time. The model used for this calculation was rearranged from Equation 16, and  $N_{SD}$  was assumed to have a Poisson error distribution:

$$\hat{N}_{SD} \sim \text{Poisson} \left[ \frac{V_{SD} \theta}{Q_{SD}} (\hat{N}_1 + \hat{N}_2) \right], \quad (17)$$

which was fit using a generalized linear model with a Poisson error distribution to determine  $\theta$ . Inserting  $\theta$  into Equations 15 and then 13 gives:

$$\hat{P}_1 = 1 - \prod_{mo=12}^4 \prod_{d=1}^{d(mo)} \left( 1 - \frac{\theta (\hat{N}_{d1} + \hat{N}_{d2})}{A_{mo}} \right). \quad (18)$$

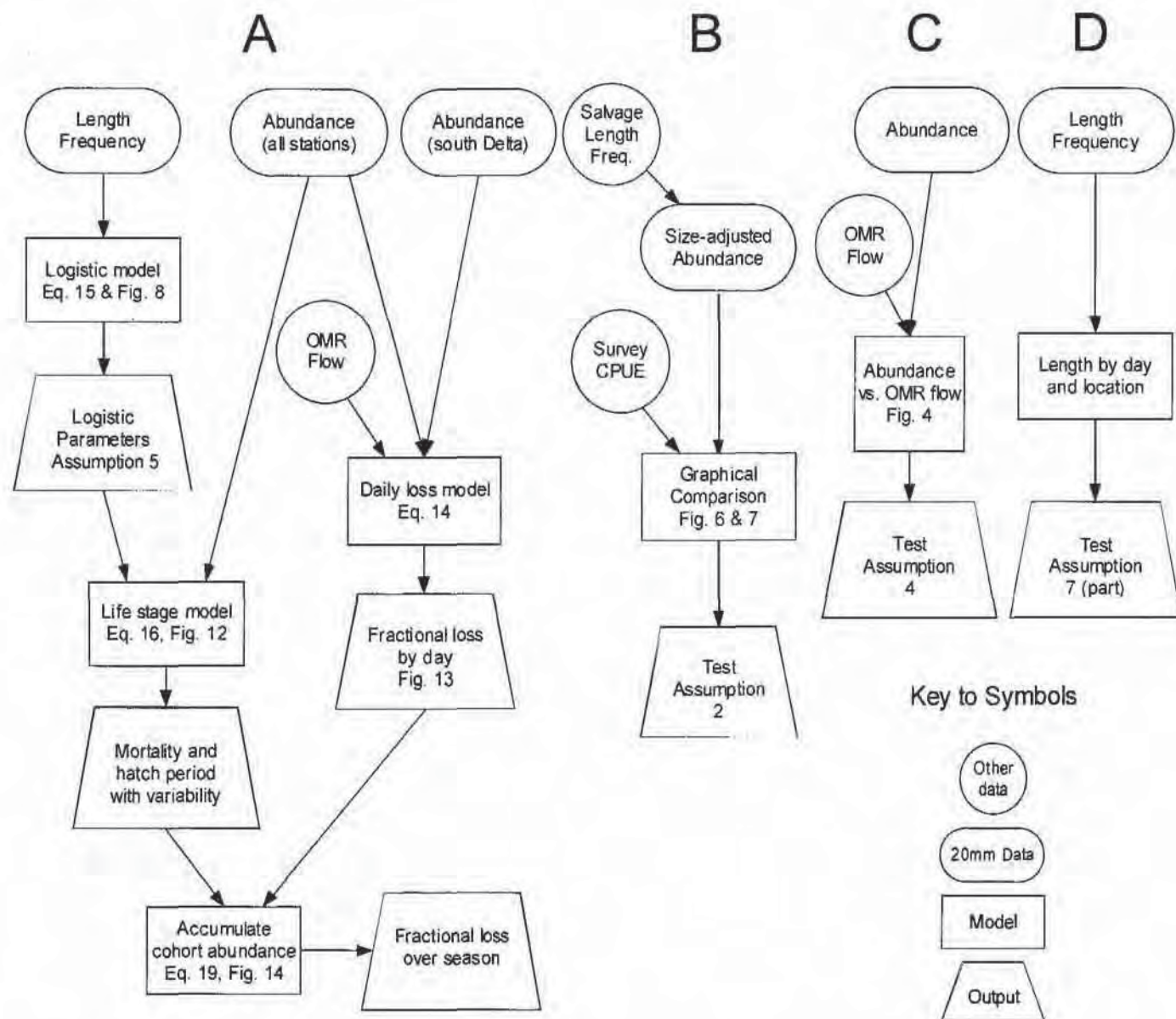
Salvage data for each day in a month were inserted into Equation 18 and divided by the monthly estimate of population size. Monthly estimates were extrapolated for two missing cases (April 2002 and January 2003), and to the previous December for all years, using the nearest non-missing month's data.

Usable salvage data are available for as early as 1995, but the Kodiak trawl data started in 2002. The mean catch per trawl in the fall midwater trawl survey for November–December was moderately well correlated with the subsequent population size from the Kodiak trawl ( $r = 0.86$  for log-transformed data). This relationship was therefore used to estimate mean population size in spring of 1995–2006 from the midwater trawl data. This mean population size was then inserted into Equation 18 as a constant for December–April of each year to calculate annual proportional losses for 1995–2006.

### Larvae/Juveniles

The general approach for young fish was similar to that for adults except that this calculation does not rely on reported salvage data, which can underestimate the abundance of small fish, and the extrapolation from daily to seasonal loss involves several additional complications. A flow-chart (Figure 5) shows the calculations required to estimate the seasonal loss, and to test some of the assumptions listed below. Several sources of error were propagated through the calculations.

The 20-mm survey has sampled twice a month during March or April to July from 1995–2005, at up to 52 stations throughout the upper Estuary (Dege and Brown 2004). I dropped surveys having fewer than 20 stations, and dropped stations in San Pablo Bay where delta smelt are uncommon. Catch per tow was converted to catch per volume (CPUE, catch per



**Figure 5.** Flow diagram for calculations to estimate losses of juvenile delta smelt. (A) Main calculation of seasonal loss as a percentage of the population. B, C, and D are ancillary calculations to test assumptions: (B) Assumption 2; (C) Assumption 4; (D) Assumption 7. A key to symbols is shown at the bottom. OMR = Old and Middle River flows. CPUE = catch per volume.

unit effort) assuming 855 m<sup>3</sup> volume per tow and net efficiency that increased to 100% with increasing size of the fish (see below). The proportional daily loss of fish to the export facilities based on a single survey was estimated as:

$$\hat{P}_{Ld} = \left( \frac{N_{SDs}}{A_s} \right) \frac{Q_{SD}}{V_{SD}} \quad (19)$$

Six stations (902, 906, 910, 914, 915, and 918) in the southern Delta nearest the fish facilities were used to calculate  $N_{SD}$  for each survey.

To calculate the total loss for the entire time-period of the 20-mm survey involves several complicating factors. Delta smelt hatch over a period of several weeks to months. The proportional loss to entrainment early in the season applies only to the fish that have hatched, so the product of daily survival values (Equation 12) underestimates overall survival. Furthermore, natural mortality (i.e., that not attributable to export pumping) suffered by the fish that hatch early requires a further discount of the proportional loss suffered by these fish. This occurs because all of the fish leave the Delta about the same date, after which vulnerability to export effects is considered negligible (the last date of the survey; see Assumption 8 below). Fish that hatch early suffer a longer period of mortality before this date, and thus contribute less to the population; therefore, losses of fish from these cohorts have less effect on subsequent population size.

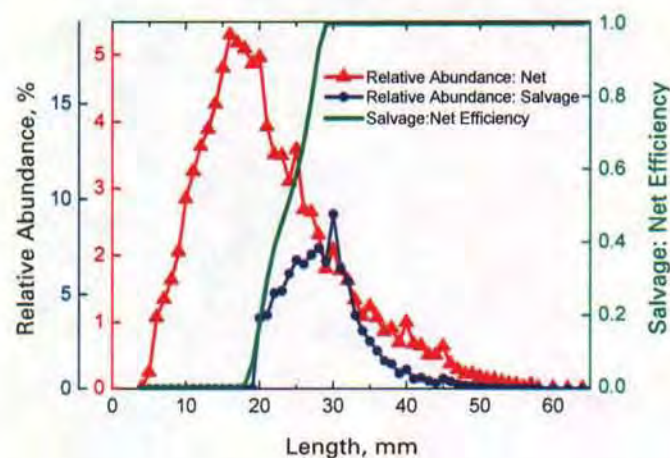
**Assumptions:** Principal assumptions for calculating daily loss for each survey were:

1. Delta smelt that arrive in the vicinity of the export facilities are lost from the population.
2. The six stations listed above provide estimates of CPUE that represent the part of the population in the water going to the export facilities.
3. Mean CPUE in all stations represents the entire population.
4. The relevant flow toward the export facilities is the southward flow in Old and Middle Rivers.

Additional assumptions needed to extrapolate daily to seasonal losses (explained below) were:

5. Capture efficiency of the 20-mm net can be described by a logistic function, increasing from 0 to 100% as fish length increases.
6. Fish hatch at a constant daily rate over some time-period.
7. Daily mortality is constant from the beginning of the hatch period until the last survey.
8. Fish remain in the Delta until some date (or temperature) rather than moving to higher salinity at a certain age.
9. Fish hatch at a 5-mm length and grow at ~ 0.3 mm d<sup>-1</sup>.

Assumption 1 seems reasonable since most of the smaller delta smelt go through the louvers at the fish facilities and are lost from the system (see below), and the few that are salvaged probably do not survive (Bennett 2005). Assumption 3 is probably true for surveys of pelagic fish (Kimmerer and Nobriga 2005). A constant hatch rate (Assumption 6) greatly simplifies the calculations, and is unlikely to have a big effect on the outcome. Daily mortality

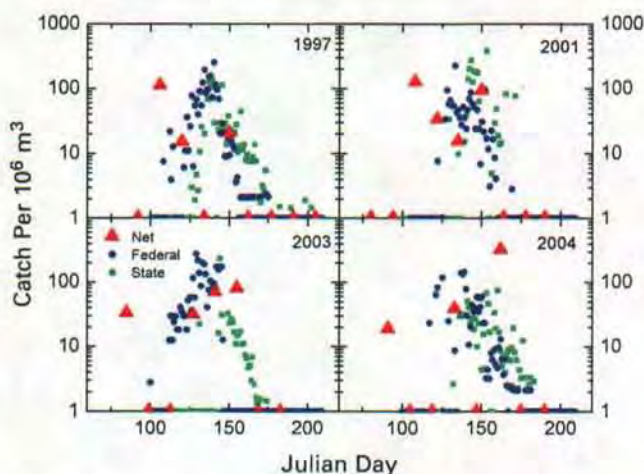


**Figure 6.** Larval/juvenile delta smelt. Length distributions for all fish caught in the 20-mm survey or in salvage, shown on different scales (left) so relative abundances overlap at ~ 30 mm. Also shown is the ratio of capture efficiency of the salvage sampling to the net sampling (right axis, solid line).

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(Assumption 7) is almost certainly not constant, but there are no data on which to base reliable estimates. The growth rate value is supported by Figure 6 in Bennett (2005), and is also the approximate mean value obtained by fitting straight lines to data on length at date.

Assumption 2 is supported by the similar temporal pattern of catches in the south Delta sampling stations and the salvage facilities (Figure 5B). To match these catches, it was necessary to account for poor sampling of small fish in the salvage facilities (Figure 6). A relative capture efficiency of the salvage facilities was calculated as the ratio of catch at each size in salvage to that in the net samples, normalized to a total of 1. Since the decline in relative abundance in the salvage data at lengths greater than the modal length was likely due to movement of the fish rather than capture efficiency, the efficiency above the mode was set to 1 (Figure 6). Then the abundance in net samples in the southern Delta was reduced by the calculated relative capture efficiency. The resulting catches per volume (examples in Figure 7) matched reasonably well in timing and magnitude, and were weakly but significantly correlated across all days when data co-occurred ( $r = 0.4$ ,  $p < 0.01$ ).



**Figure 7.** Examples comparing abundance of young delta smelt in the 20-mm survey and in the two fish facilities. Data from the 20-mm survey have been corrected by the relative capture efficiency of the fish facilities (green line in Figure 6) to allow direct comparison.

Assumption 4 (Figure 5C) is supported by the pattern of catch of juveniles in the salvage facilities vs. Old and Middle River flow (Figure 4C, D). Larval/juvenile delta smelt were rarely caught when flow was northward (positive).

Assumption 8 (Figure 5D) is supported by the salvage data in Figure 3: if smelt were moving to brackish water (and then becoming invulnerable to export entrainment) at a certain age, life stage, or length, the mean size in the export facilities would initially rise and then level off. Instead, the mean size increases throughout the spring, and the fish rather abruptly disappear (Figure 3, lower right). This pattern is also supported by the similarity in apparent growth rate from the 20-mm catches from the south Delta compared to that from catches from the entire system (not shown).

**Net efficiency:** The function describing capture probability as a function of fish length is:

$$E_L = \left( 1 - \frac{1}{1 + ae^{bL}} \right) e^{kL}, \quad (20)$$

where  $a$ ,  $b$ , and  $k$  are parameters to be determined. The logistic term in parentheses is small at small size and increases sigmoidally to 1 at large size. The other term contains mortality (and declining capture efficiency) per increment of length to express the decreasing catch as fish grow. This term was used only to fit this equation, and only the logistic parameters  $a$  and  $b$  were used in subsequent analyses. Parameters were determined by using a least-squares optimization procedure (function *optim* in S-Plus, Venables and Ripley 2003) to fit Equation 20 to the overall length-frequency distribution. Data from each year were used to determine these parameters, which provided means and confidence intervals for each parameter.

The logistic fits to the length-frequency data show that the 20-mm net is 50% efficient at about 16 mm, with a 12-mm window around that value in which efficiency increases from 10% to 90% (mean parameters; Figure 8). The fit of the model to the overall length frequencies is good ( $r^2 = 0.99$ ). The proportion of the population at 5-mm length (hatch

length) varied approximately three-fold with parameters at their upper and lower 95% confidence limits (Figure 8B). These values for the logistic parameters were used to propagate error in subsequent analyses.

**Mortality rates and hatch dates:** These were estimated by fitting data from all stations for each year to the following equations:

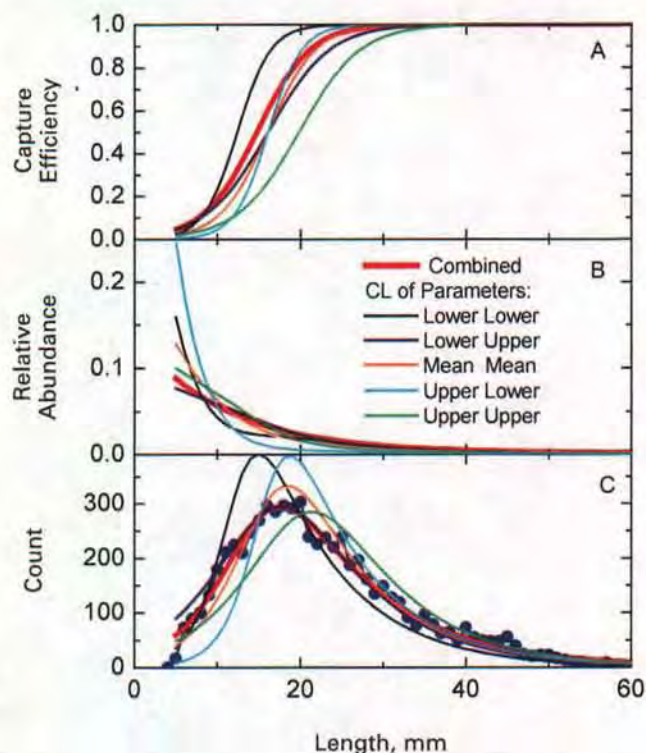
$$\left\{ \begin{array}{l} A_{L,t} = H e^{-m(t-T_j)}, T_0 \leq T_j \leq T_1 \\ A_{L,t} = 0, \quad T_j < T_0 \text{ or } T_j > T_1 \end{array} \right\},$$

$$L = (t - T_j) g \quad (21)$$

which describes the number of fish of cohort  $j$  on each day  $t$  given that  $H$  fish hatched on day  $T_j$  during an interval  $(T_0, T_1)$ , with constant growth rate  $g$  and mortality rate  $m$ . The daily hatch rate  $H$  cancels out of calculations of proportional losses, so this is an arbitrary parameter that was set to 1. The calculated abundance values  $A_{L,t}$  were adjusted for inefficient sampling of small fish using the logistic function from Equation 20, then the length data were aggregated into four length classes of equal size to reduce the number of zeros in the data. The data from each year were then fitted to these equations by an iterative search procedure that minimized the sum of squared deviations between the data and the model to estimate the hatch period  $(T_0, T_1)$  and the mortality  $m$ .

**Daily and seasonal losses.** The proportional loss for each survey was determined from Equation 19. To determine daily losses  $P_{Ld}$  from the proportional loss by survey, I interpolated the fraction in parentheses in Equation 19 for days between surveys, and extrapolated the fraction for the first survey back to the calculated first hatch date  $T_0$ . These fractions were then multiplied by the daily value of  $Q_{SD}$ , the southward flow in Old and Middle Rivers. The resulting daily proportional loss is a mortality rate and comprises part of the mortality  $m$  determined using Equation 21. Natural mortality (i.e., mortality not due to export losses) was calculated as the difference between mortality determined using Equation 21 and the effective mortality due to export effects:

$$\hat{m}_n = \hat{m} - \ln(1 - \hat{P}_{Ld}) \quad (22)$$



**Figure 8.** Fit of the net-efficiency model (Equation 20) to the count data from the 20-mm survey. Data for each year have been reduced to the same total number of fish (593) to even out all years. Each panel contains lines based on combinations of the two model parameters: both at their mean values, or either at their upper and lower 95% confidence limits. (A) Capture efficiency as logistic functions of length; (B) Relative abundance by length from the overall model; (C) Count data from the reduced data set (symbols) and model fits, which are proportional to the products of the curves in panels A and B.

where the average was taken over the season from  $T_1$  to the last survey. I used these estimated mortality values for each year in the subsequent calculations, but made parallel calculations with no mortality for comparison.

Survival of each day's cohort  $j$  from its hatch date to the last survey day was calculated as:

$$\hat{S}_j = \prod_{T_j}^{T_f} e^{-\hat{m}_n} (1 - \hat{P}_{Ld}) \quad (23)$$

The proportional loss of fish up to final day  $T_f$  was

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then determined from the abundance of all cohorts on that day divided by the abundance in the absence of export losses:

$$\hat{P}_L = 1 - \frac{\sum_j \prod_{T_j} e^{-\hat{m}_n} (1 - \hat{P}_{Ld})}{\sum_j \prod_{T_j} e^{-\hat{m}_n}} \quad (24)$$

The calculation was run for each year of the 20-mm survey separately to determine a proportional loss. Each year's calculation was run 100 times using three sources of variability. Variability in abundance ratio (in parentheses in Equation 19) was determined by bootstrap sampling of the abundance ratios determined from field data for each year; this variability was propagated by sampling from a normal distribution with mean and standard error from the bootstrap analysis, truncated to 1.6 standard deviations (middle ~ 90% of the values) to prevent extreme values. The logistic parameters for each run (Equation 20) were determined by sampling from a normal distribution with the mean and standard deviation of the parameter, determined as described above. The growth rate used in the model was determined by sampling from a uniform distribution over the interval (0.2, 0.4), since there is insufficient information to determine variability in growth rate.

Equations 19 and 24 were also used to calculate proportional losses for hypothetical export flows. I calculated Old and Middle River flow by assuming a 1:1 reduction of Old and Middle River flow for each increase in export flow. I also assumed that the spatial distribution of delta smelt does not change with the changes in Old and Middle River flow, provided that flow remains negative.

Output from a particle tracking model (DSM-2 PTM, Kimmerer and Nobriga 2008) was used in a comparison with the results from this analysis. The PTM was run for 30 days with particles released at 31 locations in the Delta. The proportion of particles lost to the pumping facilities was determined for each release location. These results were aggregated using a weighting factor equal to the proportion of delta smelt < 10 mm at sampling stations close to each

release site during dry years. The use of small fish in dry years was meant to ensure weighting toward likely spawning locations, i.e., initial locations for larvae. The PTM results were analyzed in a regression including export flow, inflow, and an interaction term, and the predictions of this statistical model were used to compare PTM output to results of the above analysis of proportional losses.

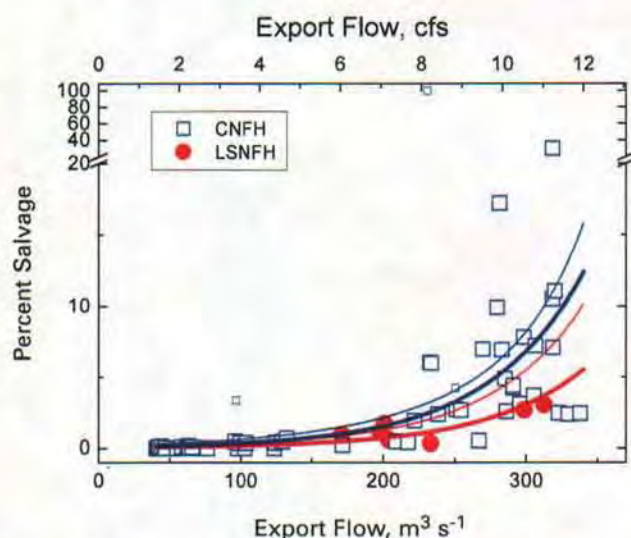
The fall index of delta smelt abundance is used as the principal measure of status of the population. Previous reports (Miller et al. 2005) documented a relationship between spatial co-occurrence of delta smelt in summer with calanoid copepods—their principal food—and the fall midwater trawl index of delta smelt abundance. Using a slightly different approach, I determined a relationship between zooplankton biomass and summer–fall survival. The independent variable was the biomass of calanoid copepods during July–October in a salinity range of 0.15–2.1 psu, the range over which 50% of the smelt occur in the summer townet survey. The dependent variable in a least-squares regression was the log ratio of the fall midwater trawl index to the summer townet index, which is an index of survival.

## RESULTS AND DISCUSSION

### Chinook Salmon

The capture of individual marked fish at Chippis Island and the fish facilities typically lasted for approximately 1 month, with the capture rate usually high for about half of the time and then gradually declining (Figure 2). On some occasions, timing was bimodal, with a few fish arriving early and the remainder in a later pulse. There was no consistent difference between timing at Chippis Island and that at either of the fish facilities.

The estimated proportion of migrating fish salvaged at the export facilities increased with increasing export flow (Figure 9). Four data points based on a small number of fish caught (four to six) were excluded from the analysis. Including these points gave a similar model fit, but diagnostic plots revealed an upward bias in the distribution of residuals. Entering the source or run of fish in the statistical model did not improve the fit according to the



**Figure 9.** Chinook salmon. Relationship of estimated proportional salvage of tagged smolts at the fish facilities,  $P_S$ , to export flow. Small symbols represent data based on six or fewer fish caught, which were not used in determining the line. Lines are from a generalized linear model with log link function and variance proportional to the mean ( $p < 0.0001$ , 57 df), with source of fish as a categorical variable. Thick lines are predictions for fish from each hatchery; thin lines are upper 90% confidence limits of the predicted mean values.

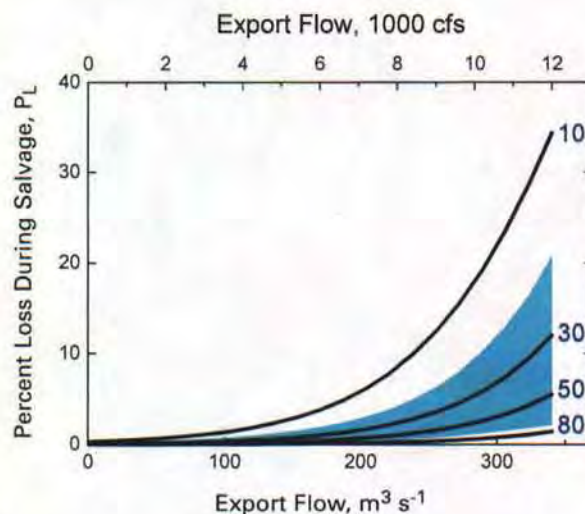
Akaike Information Criterion (320.9 without, 321.3 with source of fish in the model), but the term for source of fish was marginally significant ( $p < 0.1$ ), and the source term reflects the fact that the LSNFH values tended to be lower than those from CNFH at the higher export flows (Figure 9). Clearly, more data at high export flows would be useful in distinguishing between the results from the two hatcheries.

There was no apparent relationship between proportional salvage or total salvage and either Sacramento River flow or mean position of the gates controlling the Delta Cross-Channel. The relationship of proportional salvage to export flow (Figure 9) had a coefficient of variation for the prediction of about 20% at high export flows.

Proportional loss increased at an accelerating rate with decreasing pre-salvage survival (Figure 10). For pre-salvage survival of 50%, proportional loss is equal to proportional salvage. Proportional loss

increases sharply as pre-salvage survival approaches 0, as is clear from Equation 6. Confidence limits on proportional loss are large (Figure 10), but the uncertainty about pre-salvage survival means that constraints on the true value of proportional loss are weak. Pre-salvage survival depends partly on pre-screen predation (Gingras 1997), but also on louver efficiency. NMFS (2004) raised questions about the efficiency of the louver systems under routine operations, when louvers must be lifted out of the water for cleaning and repairs.

Post-salvage mortality was assumed to be small, and is generally considered to be low because of high survival in tests of handling and trucking procedures (NMFS 1997). However, there is no information on survival of these fish after release, and anecdotal evidence suggests high predation rates on the released fish. If survival is low, salvage (Figure 9) would have to be reduced by the fraction of released fish that do not survive. This would have a substantial influence on losses only if pre-salvage survival were high (Figure 10).



**Figure 10.** Calculated proportional loss of Chinook salmon,  $P_L$ , as a function of export flow and the pre-salvage survival term  $S_S$ , assumed to be the same for both fish facilities (Equations 6 and 11). Numbers on right give  $S_S$  as percent. Band gives 90% confidence limits around the 30% value based on the error term from Figure 9.

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Other sources of uncertainty include the swimming speed of the fish, sampling efficiency, and differences between results from fish raised in the two hatcheries. None of these is likely to be comparable to the uncertainty in pre-salvage survival. Swimming speed may vary among releases, e.g., with net flow at Chipps Island or temperature. It may also be biased, which would influence the absolute values of the salvage and loss proportions.

Since the Chipps Island flux is determined using nets, and that at the export facilities using salvage, any difference in efficiency between the two sampling methods that is not taken into account will introduce error. I assumed that net efficiency is 100%; a lower efficiency would result in an underestimate of the fish flux past Chipps Island. A comparison between a midwater trawl and a larger Kodiak trawl in the Sacramento River revealed no difference in fish per volume, suggesting that the efficiency of the midwater trawl is high (Brandes et al. 2000).

All of these calculations refer to direct losses only. Indirect losses may be large (NMFS 1997) but have not been estimated, nor has a method been developed to estimate them. This was supposed to have been the focus of investigations using mark-recapture approaches, but to date these studies have not provided insights into this question (Brown and Kimmerer 2006). Mark-recapture studies have shown that survival of fish released into the interior Delta is lower than that of fish released in the lower Sacramento River, and the ratio of these survivals is a weak function of export flow (Newman 2003). However, these results say nothing about the potential role of indirect mortality, i.e., the likelihood that fish die during migration from the Delta as a result of altered hydrodynamic conditions. This is clearly an area for further investigation.

Even without estimates of indirect loss, the losses in Figure 10 are higher than expected based on management targets for the Delta. Take limits at the state and federal fish facilities for winter Chinook salmon are based on a calculated 2% of the estimated passage through the Delta. This assumes that roughly half of the fish identified by size as winter Chinook are actually winter Chinook. The sources of the hatchery-

tagged fish are unambiguous, and considerably more than 1% of them are lost at high export flows for any value of pre-salvage survival  $< \sim 20\%$  (Figure 10).

## Delta Smelt Adults

Monthly population estimates declined beginning approximately in March, when the adults begin to spawn and die (Figure 11A). Estimated losses to entrainment began in mid-December, peaked in January, and then declined sharply (Figure 11B) as the population declined and the southward flow in Old and Middle Rivers decreased (Figure 11C).

The calculated value of  $\theta$  was  $29 \pm 20$  (95% confidence limit, 13 df). If the Kodiak trawl were 100% efficient, approximately 30 times more fish were entrained than salvaged. This ratio would be even higher if the Kodiak trawl were  $< 100\%$  efficient. A louver efficiency of 13% (see above) combined with 75% pre-screen losses for both facilities gives an overall pre-salvage loss of 97%, consistent with the above ratio but likely coincidental given the uncertainties in both estimates.

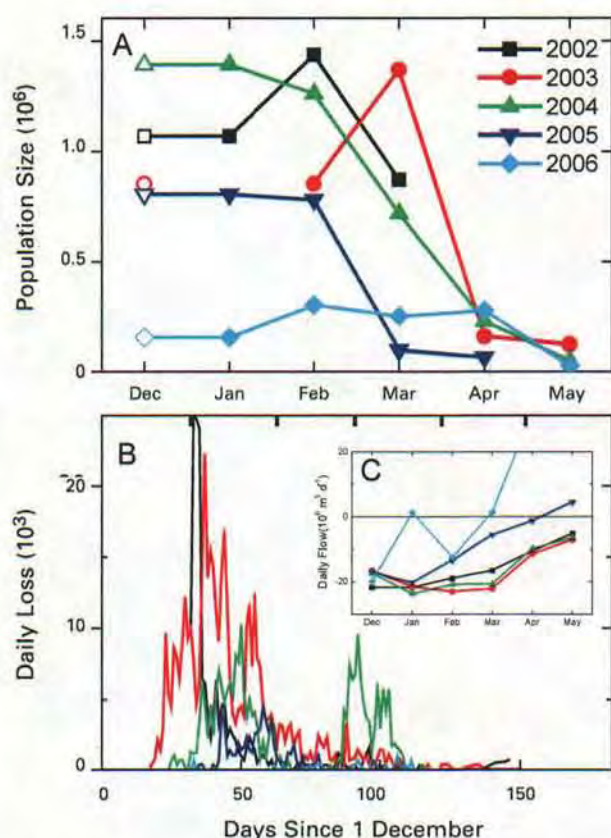
With the estimated value of  $\theta$ , the cumulative loss over the season ranged from 3% to 50% (Table 3). If the upper confidence limit of  $\theta$  is used, the values range from 6% to 69%. These confidence limits are somewhat underestimated because sampling error in the Kodiak trawl survey could lead to higher or lower estimates of population size.

Examining data back to 1995, southward flow in Old and Middle Rivers was highest in 2002–2004 and low during the wet years of the mid-1990s (Figure 12A).

**Table 3.** Estimated cumulative losses of adult delta smelt to entrainment in the south Delta water export facilities.

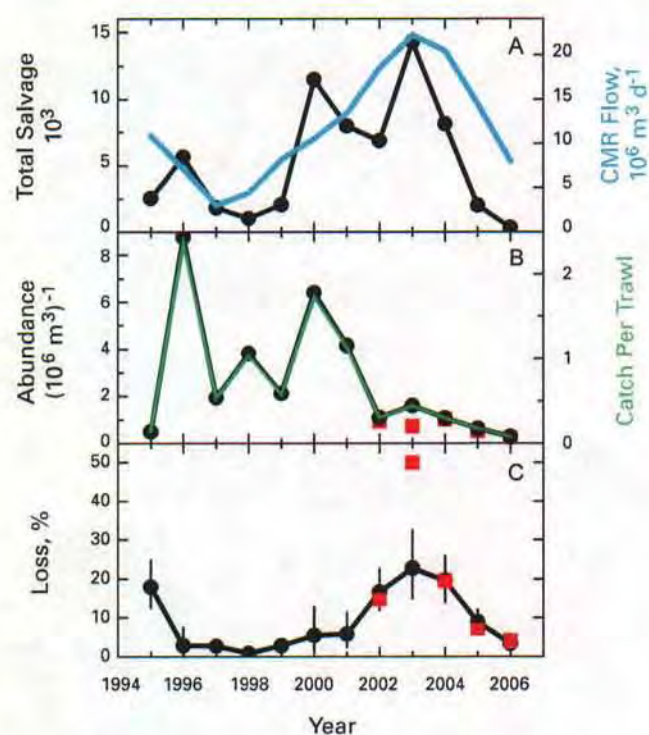
Year	Cumulative % Loss	95% Confidence Limits
2002	15	5 – 24
2003	50	19 – 69
2004	19	6 – 31
2005	7	2 – 12
2006	4	1 – 6

This pattern was followed by annual salvage estimates for December–March. Spring abundance was estimated accurately from the midwater trawl data, except for an over-estimate in 2003 (Figure 12B). During that year, no Kodiak trawl survey was taken in January, and the abundance in March was higher than that in February (Figure 11A), so that value is highly uncertain. The extrapolated Kodiak trawl estimates were higher for years before 2002 than during or after 2002 (Figure 12B). Calculated losses followed those determined above, with 2003 again the excep-



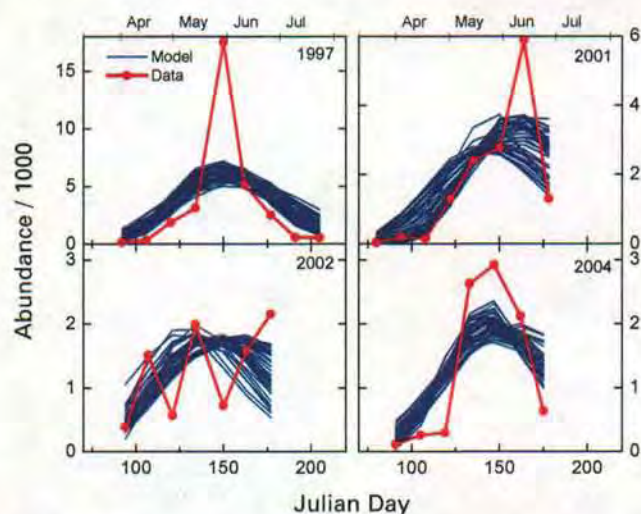
**Figure 11.** Adult delta smelt. (A) Estimated population size based on the Kodiak trawl survey; open symbols indicate that data for December were extrapolated back from the first survey of the following year; (B) Daily entrainment toward the fish facilities, which is salvage corrected for the ratio of capture efficiency of the Kodiak trawl to that of the fish facilities, so that these values are directly comparable to those in panel A; (C) Monthly mean of the daily combined flow in Old and Middle Rivers (positive northward, away from the export facilities).

tion. The highest monthly salvage occurred during January 2003 (Figure 11B), again possibly reflecting an underestimate of population size in the Kodiak trawl data. Overall, mean proportional losses varied from near 0 to 23% (Figure 12C), with a trend reflecting that of Old and Middle River flow ( $P_L = -3.7 + (1.1 \pm 0.4) Q_{SD}$ ,  $r^2 = 0.75$ , 10 df). The relationship of percent loss to  $X_2$  was weak and not significant, presumably because Old and Middle River flow is a more proximate cause of variability in percent loss than  $X_2$ .



**Figure 12.** Reconstruction of export losses of adult delta smelt for 1995–2006. (A) Total salvage (line with circles) and Old and Middle River flow (line, right axis); (B) Predicted (line with circles) and measured (squares) population abundance, and mean catch per trawl for the fall trawl surveys in November and December (line, right axis); (C) Predicted (error bars, 5th and 95th percentiles) and measured (squares) proportional losses to export entrainment.

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**Figure 13.** Larval/juvenile delta smelt. Examples of abundance by survey (line with circles) and example trajectories from repeated model runs with parameters sampled from their respective statistical distributions (thin lines).

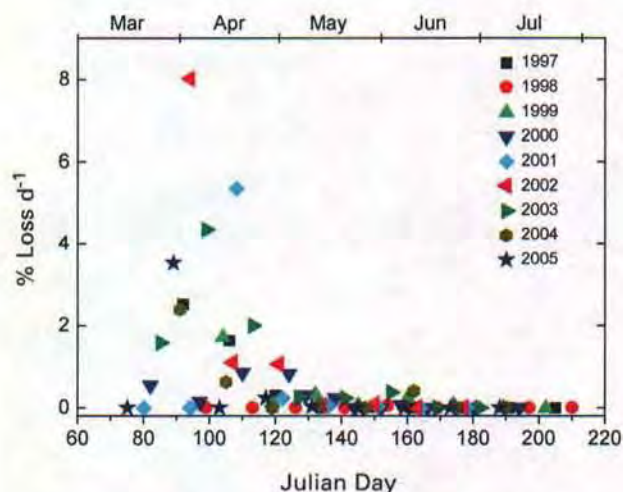
### Delta Smelt Larvae/Juveniles

The fits of the model of hatch dates and mortality (Equation 21) for each year were variable; of course the model failed to capture peaks in abundance (Figure 13), but the trends through the season were satisfactory for accumulating losses through the season. Modeled hatch dates and mortality rates varied among years (Table 4). These mortality rates seem low, but this is probably an artifact of the use of a single mortality rate for the entire period from hatch to migration.

The proportional loss data for each 20-mm survey showed a broad peak centered approximately in early April (Figure 14). Losses were low after mid-May and zero after mid-June. The seasonal or annual proportional loss was also highly variable among years, and roughly followed the maximum daily loss for each year (Figure 15). During the dry years 2001–2003, the losses were ~ 25%. Setting the natural mortality to zero raised the highest percentage loss to 37% (Figure 15). Increasing export flow to the maximum resulted in proportional losses up to 62%. The variation in annual loss was related to flow conditions ( $P_L = -0.4 + (1.7 \pm 0.6) Q_{SD}$ ,  $r^2 = 0.79$ , 9 df), but this

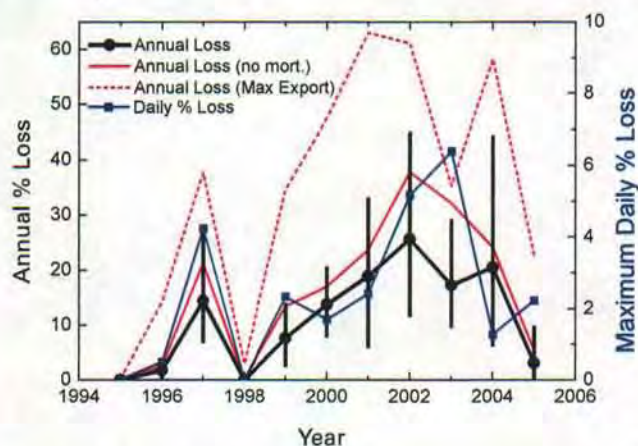
**Table 4.** Juvenile delta smelt. Estimated hatch dates and mortality by year from the 20-mm survey.

Year	Natural Mortality mn, d <sup>-1</sup>	Hatch Dates	
		Earliest	Latest
1995	0.034	03/14	06/07
1996	0.039	03/16	05/13
1997	0.040	03/20	05/12
1998	0.027	03/11	05/02
1999	0.052	03/21	06/09
2000	0.029	03/25	05/15
2001	0.027	03/19	05/09
2002	0.038	03/07	05/12
2003	0.024	03/10	06/09
2004	0.030	03/13	04/28
2005	0.028	03/12	05/03



**Figure 14.** Seasonal pattern of daily proportional loss from the larval/juvenile delta smelt population with symbols and colors for each year.

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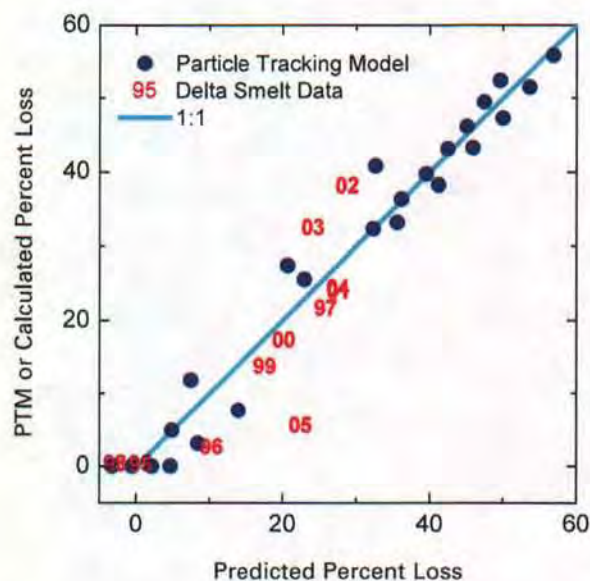
**Figure 15.** Estimated annual losses to export pumping of delta smelt from the 20-mm survey. The black line gives the estimated loss with 95% confidence limits allowing for mortality; red lines give annual losses without mortality (solid), and at the maximum export flow rate (dashed). The blue line with squares (right axis) gives the maximum daily percent loss determined in a single survey for each year.

relationship is tautological, since Old and Middle River flow was used explicitly in the calculations. This contrasts somewhat with the situation for adult delta smelt, for which the calculated losses were not based on flow, although flow was used in the calculation of  $\theta$  (Equation 17).

The statistical analysis of output from the particle tracking model showed a reasonable ability to predict the loss of particles to export pumping from inflow and export flow (Figure 16). Placing the data from Figure 15 in the same framework gives predicted and calculated values that fall rather close to the same line, except for several values below the line at intermediate flow conditions and predicted loss rates (Figure 16). The calculated percent loss for 2005 was especially low, possibly because population abundance was so low.

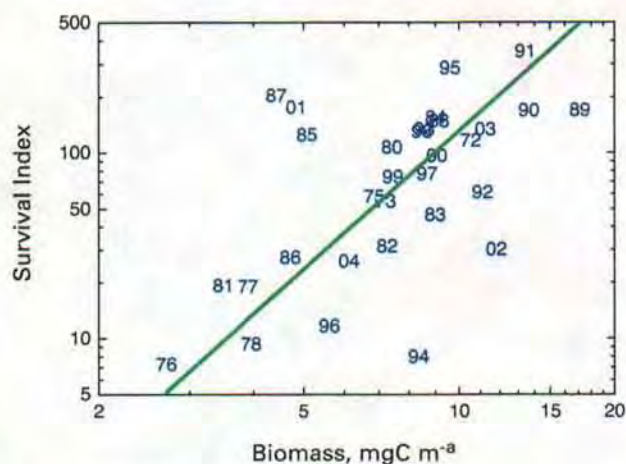
The relationship of proportional loss to Old and Middle River flow (by assumption) and inflow and export flow (Figure 16) guarantees a relationship with  $X_2$ . Could this relationship underlie the weak negative relationship between  $X_2$  and summer townet index for delta smelt after 1981 (Kimmerer 2002 Figure 8E)? A regression of summer townet index

on  $X_2$  for 1995–2005 had a slope of  $-0.11 \pm 0.18$  (95% CL, 22 df,  $p \sim 0.2$ ). A regression of survival (1 – proportional loss) from the above analysis on  $X_2$  had a slope of  $-0.009 \pm 0.004$  (9 df). The large confidence interval around the slope for the townet index includes the slope for the survival data. Applying the relationship in Figure 16 to all of the historical data for inflow and export flow replicates the  $X_2$  effect that existed after 1981, but, in contrast to the historical data (Kimmerer 2002), there is no apparent change in the slope of the calculated  $X_2$  effect. Thus, while the relationship of townet index to  $X_2$  after 1981 is consistent with a mechanism based on high export losses during periods of landward  $X_2$ , this mechanism cannot explain the positive slope with  $X_2$



**Figure 16.** Larval/juvenile delta smelt. Predicted percent loss to the population by regression using log of Delta inflow and log of export flow as predictors (with interaction), and particle-tracking model results as the dependent variable (circles), with the line indicating a 1:1 relationship. The regression is:  $\log(y) = 4.29 - (0.36 \pm 0.17) \log(\text{inflow}) - (0.90 \pm 0.11) \log(\text{export flow}) + (0.10 \pm 0.03) \log(\text{inflow}) \times \log(\text{export flow})$ , parameters with 95% confidence limits. Estimates of delta smelt losses from Figure 15 with no natural mortality (to match the particle tracking model results) are plotted against predictions from the above statistical model using mean flow conditions during the hatch period; numbers indicate years.

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**Figure 17.** Relationship of survival index (fall trawl index / summer tow net index) of delta smelt vs. mean zooplankton biomass during July–September for all stations in a salinity range of 0.15 to 2.09, the central 50% of the summer delta smelt distribution. The line is the geometric mean regression for log(10)-transformed data,  $y = 2.48x - 0.36$ . The correlation coefficient for the log-transformed data is 0.58 with a 95% confidence interval of (0.26, 0.78).

observed before 1981 (Kimmerer 2002). The causal mechanism for that relationship, and the reasons for the change, remain unknown (Bennett 2005).

The summer–fall index of survival varied over a range of 50-fold, and was significantly related to summer zooplankton biomass in the low-salinity zone (Figure 17). This may indicate food-limited survival. Observations of evidence for food shortage using histopathological methods (Bennett 2005) provides some support for this interpretation.

### Population Consequences

Are these proportional loss rates excessive? This question cannot be answered using science alone. From a scientific perspective, all we can do is compare these losses with other sources of mortality or other data about the populations.

For Chinook salmon, a loss rate on the order of 10% or less, depending on pre-screen mortality (Figure 10), is less than fishing mortality: harvest index for all Chinook salmon off California in recent years has

been around 40% (Williams 2006), which is close to fishing mortality rate for reasonable values of natural mortality. The harvest index for winter Chinook has probably been closer to 20% in recent years (Grover et al. 2004). From a population maintenance standpoint, the calculated loss rate at the export facilities would be a significant component of direct anthropogenic mortality. Furthermore, to the extent that the ocean fishery is supported by the large fall-run hatcheries, fishery losses could be offset by higher hatchery production. However, this level of additional mortality at the export facilities may place constraints on the rate of recovery of the listed winter- and spring-run stocks, and on ocean harvest of stocks (such as the fall run) that are not listed. Furthermore, these constraints may grow for winter Chinook if export flows continue to be kept high in winter to reduce impacts in spring.

Clearly, the big unknown is the pre-screen mortality. Although experiments have been conducted to attempt to determine this value, these have been hampered by incomplete design and by high variability. Furthermore, systemic problems with the operations and maintenance of the fish facilities (NMFS 2004) may prevent not only determining these factors but reducing them to an acceptable level. Thus, it is imperative that experimental designs be developed to better quantify pre-salvage survival if the current export configuration is to remain.

Delta smelt may suffer substantial losses to export pumping both as pre-spawning adults and as larvae and early juveniles. In contrast to the situation for salmon, pre-salvage mortality has been constrained in the calculations for adult delta smelt, and its effects eliminated from the calculations for larval/juvenile delta smelt. Combining the results for both life stages, losses may be on the order of 0–40% of the population throughout winter and spring. The estimates have large confidence limits, which could be reduced by additional sampling, particularly to estimate  $\theta$  in Equation 18. If there is interest in improving these estimates further, some attempts should be made to examine the assumptions not fully tested above, particularly those used in extrapolating larval abundance to hatch dates.

Although the upper bound of this range represents a substantial loss, the effect of this loss is complicated by subsequent variability in survival (Figure 17). If this variability is uncorrelated with entrainment losses, then these losses will contribute little to the variability in fall abundance index. The simplest way to evaluate this is by regression of fall midwater trawl index on winter-spring export flow, but this relationship is contaminated by the downward step change in abundance in approximately 1981–1982, together with the long-term upward trend in export flow (mainly up to the mid-1970s, see Kimmerer 2004). Including this step in a regression model eliminates the effect of export flow on the fall midwater trawl index (coefficient =  $-1.5 \pm 2.4$ , 95% CL, 36 df). It seems unlikely that the downward step change was due to the earlier increase in export flow; furthermore, despite substantial variability in export flow in years since 1982, no effect of export flow on subsequent midwater trawl abundance is evident.

This is not to dismiss the rather large proportional losses of delta smelt that occur in some years; rather, it suggests that these losses have effects that are episodic and that therefore their effects should be calculated rather than inferred from correlative analyses. In the absence of density dependence, using means in Figure 15 with natural mortality, fall abundance should have been reduced by ~ 10% during 1995–2005. This would have an equivalent effect of reducing the summer–fall survival index by 10%. This would have made little difference to fall abundance in the context of the approximately 50-fold variation in summer–fall survival (Figure 17), and would be difficult to detect through correlation.

Although summer–fall survival appears to dominate variability in abundance of delta smelt in fall (Figure 17), this does not imply that control of export effects would be fruitless, as these effects can be considerable during dry years. Management of delta smelt should incorporate any opportunities that arise to improve habitat or food supply and to reduce any negative impacts of predation or toxic contamination. However, current evidence does not provide a clear path toward improving the status of delta smelt using these factors. Manipulating export flow (and, to some extent, inflow) is the only means to influ-

ence the abundance of delta smelt that is both feasible and supported by the current body of evidence, even though export effects are relatively small. The results presented here can be used to suggest when, and under what conditions, control of export effects would be most helpful.

## ACKNOWLEDGMENTS

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## **APPENDIX DOC. 11**

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ESTUARY & WATERSHED SCIENCE**  
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# Investigating Particle Transport and Fate in the Sacramento-San Joaquin Delta Using a Particle Tracking Model

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## ABSTRACT

Movements of pelagic organisms in the tidal freshwater regions of estuaries are sensitive to the movements of water. In the Sacramento-San Joaquin Delta—the tidal freshwater reach of the San Francisco Estuary—such movements are key to losses of fish and other organisms to entrainment in large water-export facilities. We used the Delta Simulation Model-2 hydrodynamic model and its particle tracking model to examine the principal determinants of entrainment losses to the export facilities and how movement of fish through the Delta may be influenced by flow. We modeled 936 scenarios for 74 different conditions of flow, diversions, tides, and removable barriers to address seven questions regarding hydrodynamics and entrainment risk in the Delta. Tide had relatively small effects on fate and residence time of particles. Release location and hydrology interacted to control particle fate and residence time. The ratio of flow into the export facilities to freshwater flow into the Delta (export:inflow or EI ratio) was a useful predictor of entrainment probability if the model were allowed to run long enough to resolve particles' ultimate fate. Agricultural diversions within

the Delta increased total entrainment losses and altered local movement patterns. Removable barriers in channels of the southern Delta and gates in the Delta Cross Channel in the northern Delta had minor effects on particles released in the rivers above these channels. A simulation of losses of larval delta smelt showed substantial cumulative losses depending on both inflow and export flow. A simulation mimicking mark-recapture experiments on Chinook salmon smolts suggested that both inflow and export flow may be important factors determining survival of salmon in the upper estuary. To the extent that fish behave passively, this model is probably suitable for describing Delta-wide movement, but it is less suitable for smaller scales or alternative configurations of the Delta.

## KEYWORDS

tidal processes, water diversions, particle tracking model, San Francisco Estuary, Chinook salmon *Oncorhynchus tshawytscha*, delta smelt *Hypomesus transpacificus*

## SUGGESTED CITATION

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## INTRODUCTION

In tidal river estuaries, freshwater flows affect hydrodynamic phenomena important to biotic communities. Examples include the geographic match or mismatch of chemically and structurally appropriate habitat attributes (Peterson 2003), strength of entrainment phenomena such as gravitational circulation and residual landward bottom currents that concentrate biota and assist retention in rearing habitats (Cronin and Forward 1979; Kimmerer et al. 2002), and flow pulses that transport larvae to rearing habitats (Dew and Hecht 1994). Thus, freshwater depletions and changes in the timing of freshwater inputs affect estuarine biota, often negatively (Jassby et al. 1995; Livingston et al. 1997).

The landward reach of California's San Francisco Estuary, known as the Sacramento-San Joaquin Delta, may be the only place in the world where significant freshwater is diverted from within a tidal estuary. Reservoir releases throughout the watershed are managed to maintain most of the Delta as a permanently freshwater ecosystem to support a significant redistribution of California's water resources from north to south (Kimmerer 2002). Four large water diversions owned by the U.S. and State of California governments collectively export an average of nearly 7 cubic kilometers per year ( $\text{km}^3 \text{ yr}^{-1}$ ) from the Delta (Table 1). More than 95% of the water exported from the Delta is taken by the two largest diversions: the Jones Pumping Plant of the federal Central Valley Project (hereafter, CVP) and the State Water Project's Banks Pumping Plant (hereafter, SWP). Existing regulations allow for up to 65% of river inflows to be diverted during certain months. The exported water is pumped to agricultural, municipal, and industrial users to the south and west; an estimated 22 million Californians use water exported from the Delta.

In addition to the water exported out of the Delta, an estimated net  $0.1 \text{ km}^3 \text{ yr}^{-1}$  also is removed during April–September to irrigate farmlands within the Delta (Brown 1982). The within-Delta farmlands are irrigated by approximately 2,200 comparatively small, privately-owned water diversions scattered throughout the system (Herren and Kawasaki 2001).

Numerous fish species migrate through or live in the upper San Francisco Estuary during all or part of their life cycles (Moyle 2002). Thus, in addition to altered hydrodynamics, the large-scale removal of freshwater from the Delta adds the potential for significant entrainment of fishes from the upper estuary. Entrainment of the early life stages of fish has been a long-standing concern (Stevens et al. 1985; Moyle et al. 1992; Brandes and McLain 2001). Elaborate facilities operate continuously at each export plant to separate fish from diverted water and return them to the estuary (Brown et al. 1996). Although mortality of some species at these facilities is probably high (e.g., Bennett 2005), correlative evidence of major entrainment effects on fish population dynamics has not been forthcoming (Kimmerer et al. 2001; Newman 2003; Bennett 2005).

A quantitative understanding of linkages between Delta hydrodynamics and fish entrainment risk has been hindered by difficulties in modeling the Delta's complex network of tidally-influenced channels, incremental changes in SWP and CVP water opera-

**Table 1.** Summary of annual export volumes ( $\text{km}^3$ ) from the four state and federal water diversions in the Sacramento-San Joaquin Delta for water years following the Bay-Delta Accord (1995–2005). The Contra Costa and Tracy diversion facilities are part of the federal Central Valley Project. The Harvey O. Banks and North Bay Aqueduct diversion facilities are part of the State Water Project.

Water Diversion	1st Year of Operation	Average Volume (range)
Contra Costa	1940	0.15 (0.12 – 0.23)
Tracy (CVP)	1951	3.1 (2.6 – 3.5)
Banks (SWP)	1968	3.6 (2.1 – 4.9)
North Bay Aqueduct	1988	0.05 (0.03 – 0.07)

tions, and the large natural inter-annual and seasonal variability in inflow. During the latter half of the twentieth century, the number of water diversions increased (Table 1), as did total water export volumes (Kimmerer 2002). Furthermore, the number of flow control structures, such as barriers and flood gates, has increased and their operation schedules have changed through time. Proposals for further modifications continue.

We used the Delta Simulation Model-2 hydrodynamic model (DSM2 HYDRO) and its associated particle tracking model (PTM) to examine the principal determinants of entrainment losses to the export facilities, under assumptions discussed below. We explored numerous combinations of freshwater inflow, export flow, and tide for a variety of particle release sites. Our goal was to provide information about Delta hydrodynamics, water diversions, and barrier operations pertinent to management of the Delta for fish. We addressed the following questions regarding hydrodynamics and entrainment risk in the Delta: (1) What effect do spring versus neap tides have on particle fate? (2) How do release location, hydrology, and time interact to influence particle fates? (3) What is the best index of export flows in the Delta to index the probability of entrainment of neutrally-buoyant particles and (possibly) resident and migratory fish? (4) What is the effect of in-Delta agricultural diversions on entrainment loss and particle residence time? (5) What is the effect of permanent and temporary barriers on entrainment loss and particle residence time? (6) How can the entrainment of the larvae of threatened delta smelt (*Hypomesus transpacificus*) be related to hydrodynamic conditions? (7) How do freshwater inflow and export flow affect the predicted passage out of the Delta of particles released at sites in the northern Delta where Chinook salmon (*Oncorhynchus tshawytscha*) smolts are released for experiments on survival?

## METHODS

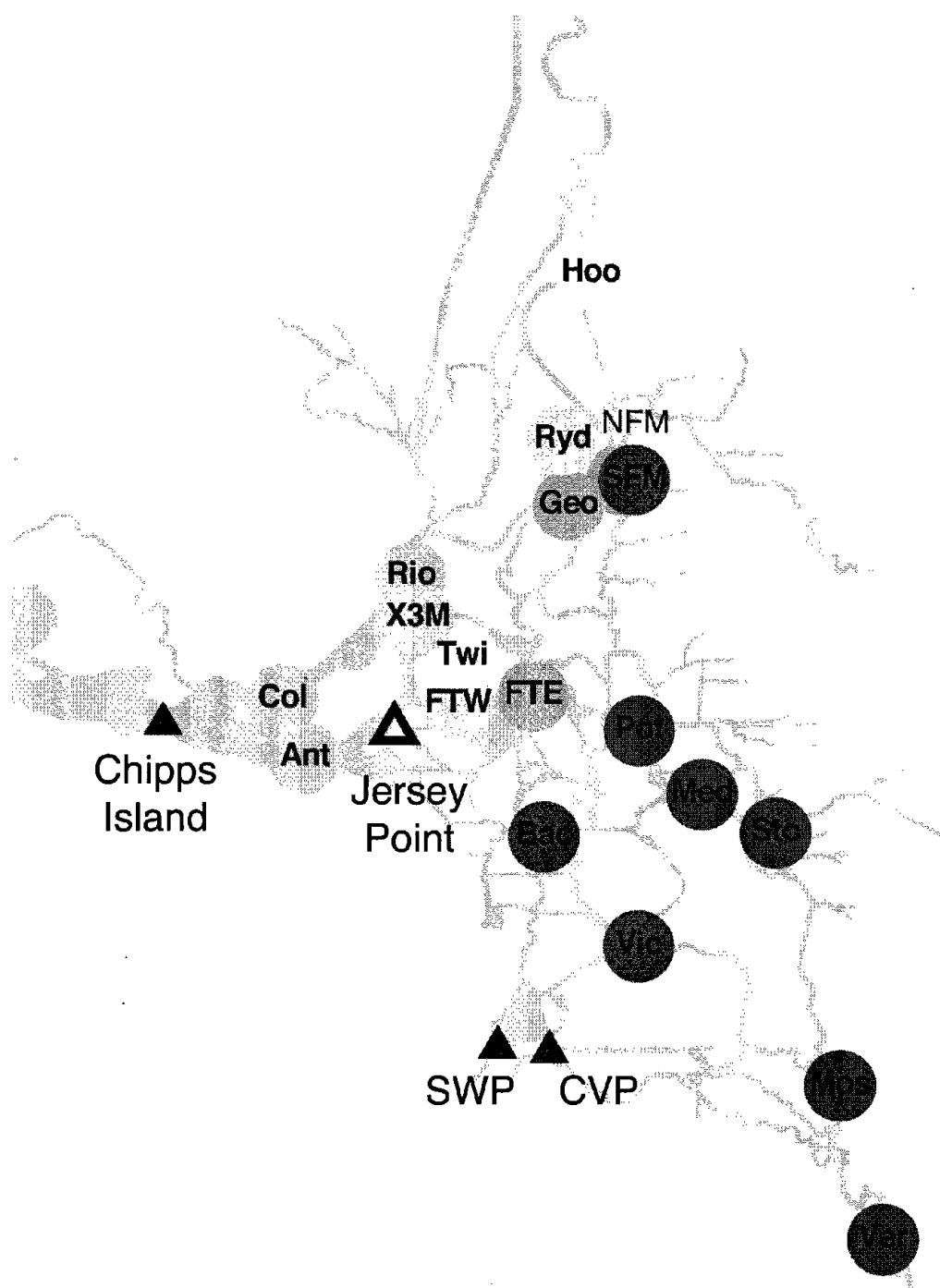
### Study Area

Numerous alterations of the Sacramento-San Joaquin Delta influence hydrodynamics and the movement of fish in the system (Figure 1). For example, the Yolo

Bypass, an artificial floodplain of the Sacramento River, is managed to take most of the winter flood flows and prevent flooding of urban areas (Sommer et al. 2001). The Delta Cross Channel (DCC) connects the Sacramento River with the interior Delta by way of a pair of movable gates, which are closed during floods and when salmon are migrating downstream. Temporary rock barriers are installed at various sites in the southern Delta to maintain water levels for agricultural diversions, and one barrier is placed at the head of Old River to prevent salmon smolts from entering it during their migration down the adjoining San Joaquin River. One objective of closing the DCC and the barrier at the head of Old River is to minimize salmon losses that can be attributed to water project operations.

### Hydrodynamic Model

DSM2 HYDRO is a one-dimensional (1-D) numerical model that simulates non-steady state hydrodynamics in a network of riverine and estuarine channels using a standard numerical method (the Preissman scheme). (See <http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/>). The chief advantages of this model are its speed, and the fact that the California Department of Water Resources (CDWR) has expended a tremendous amount of effort and care in developing, calibrating, and testing this model. The model grid consists of 416 nodes and 509 links representing channels, and open-water areas, which are represented as reservoirs where mixing occurs. Seventeen hydraulic barriers and gates are also included. DSM2 HYDRO's primary dependent variables are stage and flow; the model boundary conditions are stage at Martinez to the west, water diversions in the Delta, and stream flows at the landward limits of tidal influence. DSM2 HYDRO was calibrated to empirical flow and stage data (May 1988, April 1997, April 1998, September–October 1998; CDWR 2001). The model's friction parameters for each of ~50 regions were adjusted until simulated values best matched observed daily average and instantaneous flow and stage data. The model calibration was validated by comparing simulated flow and stage with field data from 1990–1999. Results of this calibration and validation are available in the form of maps with select-



**Figure 1.** Map of the Sacramento-San Joaquin Delta showing release sites used in the particle tracking model. Sites are identified by codes listed in Table 4, and color-coded by the mean losses from each site to the SWP and CVP pumps. Blue triangles identify additional locations where particle passage was recorded: Chipps Island in the western Delta, and the federal and state water export facilities. The open triangle denotes an intermediate passage location at Jersey Point; others are at Georgiana Slough (Geo), the nearby DCC (not shown on map), and Rio Vista (Rio). The NFM site is covered by the SFM symbol. The Sac site is just north of the area shown on the map.

able nodes that link to graphical displays of model results and data (see <http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/dsm2studies.cfm>).

DSM2 QUAL is a transport module that has been similarly calibrated against conductivity measurements at various Delta locations. This provides some assurance that the movement of substances, and therefore also neutrally-buoyant particles, is accurately represented, since both models use the same hydrodynamic output. However, PTM (see below) uses a very different scheme for velocity profiles and for mixing at junctions. Furthermore, model accuracy varies depending on the length of the simulation and the location of particle releases. The most recent calibration is available, also in the form of graphical displays, at <http://modeling.water.ca.gov/Delta/studies/calibration2000/>.

The DSM2 particle tracking model (PTM) is a quasi-3-D extension of DSM2 HYDRO (Culberson et al. 2004). The PTM represents movement of particles through advection in the mean flow together with a synthetic dispersion (Wilbur 2000; 2001). Each particle has a random component of movement—a random walk (Visser 1997)—and its position in the channel is tracked. Lateral velocity profiles are assumed to have a fourth-order polynomial description, and vertical profiles are logarithmic. Thus, particles may encounter velocities that differ substantially from the mean flow. These profiles are the same for all channels and therefore do not take into account channel shapes, nor do they make use of the change in vertical profiles that should accompany the bottom friction coefficients used to tune the hydrodynamic model. The combination of random movement and velocity shear results in dispersion of particles. However, upon reaching a junction or an open-water area, a particle is completely and instantaneously mixed, destroying information about its previous relative position in the channel. This is likely to have a significant effect on dispersion but this cannot be determined without re-coding the PTM. Velocity profiles used in the PTM were determined by fitting the profiles to velocity data collected at 16 sites in the Delta (Oltmann 1998; Wilbur 2000). The simulated quasi-3-D profiles were checked using simulations of dye concentration data collected from three stations following a single dye

release on the San Joaquin River; arrival time was reproduced well, but dispersion was less well predicted (Wilbur 2000).

Despite the extensive use of the DSM2 family of models to solve important management problems in the Delta, the calibrations and validations described above do not provide sufficient information for users to assess the accuracy or reliability of model output. There is no published record of the overall statistical properties of the models. To avoid relying on such uncertain foundations, we have conducted a partial analysis of the statistical properties of HYDRO and QUAL in relation to field data, and present our findings in the Appendix. This analysis is quite encouraging about the utility of these modules for the analysis of movements of water and salt on the scale of the Delta. However, we have not evaluated the extent to which the PTM reliably records the movement of particles. The comparisons with field data described above do not constitute a sufficient calibration of PTM. This shortfall could be addressed indirectly through a comparison of particle releases in PTM with tracer releases in QUAL, but that is beyond our scope. Furthermore, the basic formulation of the PTM has not been subjected to peer review.

Although the DSM2 models are simpler than others in use in this and other estuaries, the number of different dimensions of a modeling problem can become unwieldy even with this model. We chose to simplify the analysis by our choices of conditions to model, and our approach to the analysis. We used synthetic hydrology and repeating tides, which were either spring tides or, in a few runs, neap tides. We focused on spring tides to maximize dispersion effects, which appeared to be small (see Results). Inflows and export flows were constant during each model run, and distributed among the various sources and sinks based on historical data from the DAYFLOW accounting program for 1980–2002 (<http://www.jep.ca.gov/dayflow/>). Inflow was distributed by a constant proportion, except for the Yolo Bypass, which flows only under flood conditions (Table 2). Export flow was constant for the North Bay Aqueduct ( $0.9 \text{ m}^3 \text{ s}^{-1}$ ) and Contra Costa Canal ( $0.09 \text{ m}^3 \text{ s}^{-1}$ ), and the remainder was apportioned between the CVP and SWP (Table 2). Agricultural diversions were set to winter values

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**Table 2.** Distributions of inflow and export flow by source for each model run.

Inflow		Inflow by Source ( $\text{m}^3 \text{s}^{-1}$ )			
cfs	$\text{m}^3 \text{s}^{-1}$	Sacramento R.	Yolo Bypass	San Joaquin R.	Eastern Delta
12,000	340	292	0	40	8
21,000	595	493	6	78	18
38,000	1,077	837	32	162	47
67,000	1,899	1,331	158	306	104
120,000	3,401	1,844	802	547	208
Export Flow		Export Flow by Source ( $\text{m}^3 \text{s}^{-1}$ )			
cfs	$\text{m}^3 \text{s}^{-1}$	SWP	CVP	Contra Costa Canal	North Bay Aqueduct
2,000	57	20	37	0.09	0.9
6,000	170	92	78	0.09	0.9
10,000	284	164	120	0.09	0.9

**Table 3.** Summary of model runs. Base runs were conducted with no agricultural diversions, south Delta barriers removed, and Delta Cross Channel (DCC) closed only for inflow greater than 38,000 cfs. "All" includes base runs, runs with agricultural diversions, releases from the north Delta with the DCC closed, and releases from Vernalis and Mossdale with various barrier configurations. In the lower part of the table, "Tide" refers to releases from all sites with neap and spring tides, "Ag Barriers" to releases from many sites with agricultural and fish barriers in place, and "Replicates" to multiple releases from the Hood site on the Sacramento River to test variability with different random number seeds.

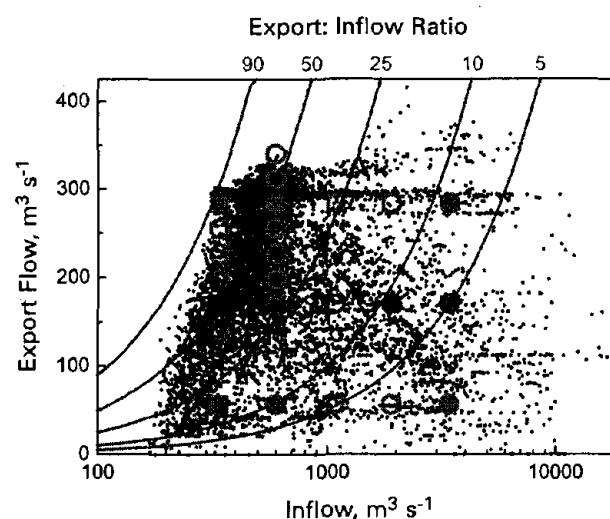
Inflow		Export Flow									
cfs	m <sup>3</sup> s <sup>-1</sup>	cfs m <sup>3</sup> s <sup>-1</sup>	2,000 57	5,000 142	6,000 170	7,000 198	8,000 227	9,000 255	10,000 283	11,000 312	12,000 340
12,000	340		All	Base	All	Base	Base	Base	All		
21,000	595		All		All	Base	Base	Base	All	Base	Base
38,000	1,077		Base		Base				Base		
67,000	1,899		Base		Base				Base		
120,000	3,401		Base		Base				Base		
12,000	340		Tide Replicates Ag Barriers		Ag Barriers				Tide Replicates		
38,000	1,077				Replicates						
120,000	3,401		Tide		Replicates				Tide		

( $0.9 \text{ m}^3 \text{ s}^{-1}$ ), except for a subset of runs in which they were set to typical summer values ( $127 \text{ m}^3 \text{ s}^{-1}$ ). Our use of minimum agricultural diversion demand in most runs reduced particle losses to agricultural diversions to  $< 1\%$  in all runs. This maximized the numbers of particles that remained in Delta channels for evaluation of study questions not involving these diversions. This choice was motivated by recent studies that suggest fish losses to small diversions are likely much less than expected based on quantities diverted (Nobriga et al. 2004; Moyle and Israel 2005). In most runs, temporary barriers in the south Delta were absent, and the Delta Cross Channel gates were open at inflow below  $600 \text{ m}^3 \text{ s}^{-1}$  and closed above, except in specific runs. These choices somewhat limit the interpretation of our results, but even so we modeled 936 scenarios for 74 different conditions of flow, diversions, tides, and barriers (Table 3, Figure 2).

## Data Analysis

For each model run, 4,000–5,000 particles were released at one of up to 20 sites (Table 4; Figure 1). Four to five thousand was approximately the maximum number of particles for which all particle fluxes could be calculated for a 90-day simulation. We always tried 5,000 particles first. If all particle fates could not be calculated, we re-ran the simulation using 4,000 particles. Equal numbers of particles were released at 15-minute intervals over the first 25 hours of each simulation to eliminate bias due to releasing particles on a particular tidal stage (Culbertson et al. 2004). Model outputs consisted of hourly cumulative proportions of particles that passed selected control points (Figure 1). Except for analysis of tidal effects, data were filtered with a Godin low-pass filter (24 hours) and averaged over each day. Data at the beginning of the series were replaced by a straight daily average since the tidal filter removes the first 24 data points. Daily averages were then truncated to 90 days for all analyses.

Particles were considered to have left the Delta if they passed Chipps Island (Figure 1) or entered either the SWP or CVP pumping plants or agricultural diversions. Intermediate points were used only to assess the pathways that the particles had taken.



**Figure 2.** Daily export flow and inflow from the Dayflow accounting program for 1980–2002 (blue symbols) and values used in the model (red). Open symbols are base run only, filled symbols are other runs as described in Table 3. Squares are combinations used in examples (Figures 5 and 6). Green lines give isopleths of export:inflow (EI) ratio.

Generally, the profile of particle passage was asymmetrically sigmoid, with a rapid initial increase in slope followed by a protracted approach to an asymptote. For some release sites, particularly those in the southeastern Delta, there were two inflections in the recovery curves, as the particles took a shorter and a longer path to the recovery site. In a few cases, particles were still accumulating at endpoints at an accelerating rate at the end of the model run.

In many runs, particularly those at low flow for release points in the central and southern Delta, a substantial fraction of the particles remained in the Delta after 90 days. To estimate the ultimate fate of these particles, we extrapolated the curves of cumulative passage to infinite time. This extrapolation used a negative exponential curve fitted to the data past the last inflection point. The inflection point was determined by smoothing the curve with a 9-day running mean, and determining the locations of peaks in the data after differencing, i.e., subtracting each value from the previous value. The last peak in the differenced series was taken as the point of the final inflection. If there were no inflection, the

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**Table 4.** Release and recovery points and codes used in the figures.

Release Site	River	Code	DSM2 Node	Study Questions
Vernalis	San Joaquin	Ver	1	1, 2, 3, 4, 5
Mossdale	San Joaquin	Mos	7	1, 2, 3, 4, 5
Stockton	San Joaquin	Sto	21	1, 2, 3, 4, 5, 6
Medford Island	San Joaquin	Med	25	1, 2, 3, 4, 5, 6
Potato Slough	San Joaquin	Pot	32	1, 2, 3, 4, 5, 6
Twitchell Island	San Joaquin	Twi	42	1, 2, 3, 4, 5, 6
Antioch	San Joaquin	Ant	46	1, 2, 3, 4, 5, 6
Bacon Island	Old	Bac	92	1, 2, 3, 4, 5, 6
Frank's Tract East	n/a	FTE	103	1, 2, 3, 4, 5, 6
Frank's Tract West	n/a	FTW	226	1, 2, 3, 4, 5, 6
Victoria Canal	Middle	Vic	113	1, 2, 3, 4, 5, 6
Three-Mile Slough	n/a	X3M	240	1, 2, 3, 4, 5, 6
South Fork Mokelumne	Mokelumne	SFM	261	1, 2, 3, 4, 6
North Fork Mokelumne	Mokelumne	NFM	281	1, 2, 3, 4
Georgiana Slough		Geo	291	1, 2, 3, 4, 5, 7
Sacramento	Sacramento	Sac	330	7
Hood	Sacramento	Hoo	338	1, 2, 3, 4, 5, 7
Ryde	Sacramento	Ryd	344	1, 2, 3, 4, 5, 7
Rio Vista	Sacramento	Rio	351	1, 2, 3, 4, 6
Collinsville	Sacramento	Col	354	1, 2, 3, 4, 6

curve was fitted to the entire data-set. We estimated the ultimate fraction of particles passing the selected location as the asymptote of the fitted curve.

In some cases the curve could not be fit to the data, or the fit was poor; generally, this occurred under low-flow conditions when particles began arriving at distant points late in the simulation and were continuing to accumulate at the end of the simulation rather than approaching an asymptote. In those cases, the 90-day value was used as an estimate of the ultimate value.

In addition to the ultimate fate of particles, we calculated a measure of residence time. The value chosen was the time for 75% of the particles to leave the Delta. We selected this value because we were most concerned about how long it takes a group of particles (representing plankton) to leave the Delta, but we also wanted a statistically robust metric. In a handful

of cases, 75% of the particles had not left the Delta by the end of the model run, and this time had to be determined on the extrapolated curve as described above. In one case it was determined by eye.

The ultimate fraction of particles lost to the export facilities and, in some model runs, to agricultural diversions, was modeled as a function of the export: inflow (EI) ratio. The EI ratio is used in management of the Delta because it is assumed to provide a measure of the influence of south Delta diversions (Newman and Rice 2002). By regulation, the EI ratio must not exceed 35% during February-June or 65% for the rest of the year. The model was a logistic curve fit to the data by using an optimizing program to minimize the sum of squared differences between the data and the curve. The curve was fit separately for each release site. In contrast to particle fate, the relationship of residence time to inflow and export

flow was examined graphically, since no underlying model seemed to apply to all release sites.

All analyses were conducted in S-PLUS (Venables and Ripley 2003). Analyses were checked at several steps to eliminate programming errors. Checks included random or systematic comparisons of unfiltered and filtered output, graphical examination of cumulative particle passage with model outputs superimposed, and other such cross-checks. Model output is available from the authors upon request.

### Case Studies

We conducted two case studies that may be helpful in thinking about managing the Delta to protect fish populations. Larvae and early juveniles of delta smelt occur in the Delta in spring when they are vulnerable to entrainment in the south Delta export facilities (Moyle et al. 1992, Bennett 2005). We used data from the California Department of Fish and Game 20-mm survey of late larval and juvenile fish (Dege and Brown 2004), selecting surveys from three years (2001–2003) of low outflow, and averaging catch per trawl of <10mm larvae for each station over all surveys. The assumption was that in these dry years the population would be slow to move out of the Delta, so the abundance of small fish could be used to approximate the spatial distribution of hatching. Each PTM release site was linked with the nearest sampling station, and the mean catch per trawl was used to provide a weighting factor for the release site. The proportion of particles that moved within 30 days from each site to the export facilities, and the mean loss weighted by delta smelt abundance, were determined for each set of flow conditions and examined graphically.

Juvenile Sacramento River Chinook salmon may be exposed to the export pumps if they stray from the Sacramento River during migration to the sea. Mark-recapture experiments have been conducted in winter in the northern Delta to examine the effect of pumping on endangered winter Chinook (Brandes and McLain 2001; Newman 2003). Fish marked with coded-wire tags are released at Ryde on the mainstem Sacramento River and in Georgiana Slough, from which they move with the net flow into the interior

Delta (See Figure 1). Fish are recaptured either in a trawl survey at Chipps Island or in the ocean fishery. The ratio of apparent survival of the two groups of fish is used as a measure of the relative survival by the two pathways, and is then related to export flow. Results of these and similar experiments conducted in the spring have been inconclusive regarding the influence of export flow and DCC gate position on subsequent survival (Newman and Rice 2002; Newman 2003). We used the ratio of particles passing Chipps Island from releases in Georgiana Slough and at Ryde as a parallel measure of “survival,” and related that to inflow and export flow.

### RESULTS

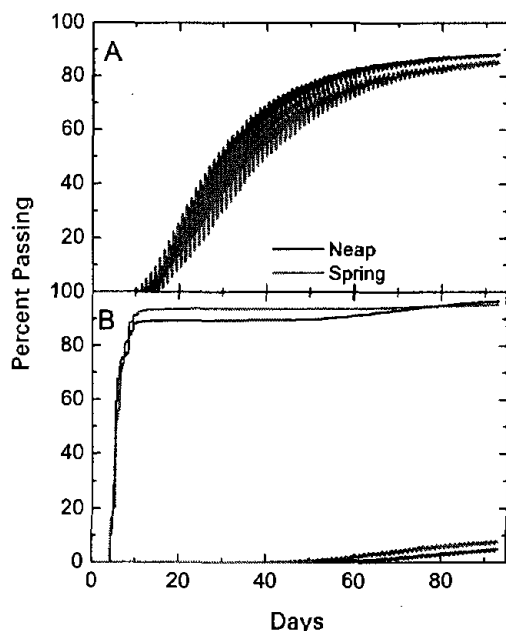
Replicate particle releases with different random number seeds resulted in minor variability in the ultimate fate of particles (Table 5). Standard deviations of the percentage of particles arriving at export facilities or Chipps Island were generally  $\sim 0.5\%$  or less. This introduces some error into our calculations, which has a minor effect on the parameters of our models.

Raw data, expressed as the cumulative percentage of particles passing a point, show tidal effects that vary with location, and to some degree, between spring and neap tide (Figure 3). For releases along the Sacramento River and western Delta with low inflow ( $340 \text{ m}^3 \text{ s}^{-1}$ ) and export flow ( $57 \text{ m}^3 \text{ s}^{-1}$ ), tidal effects were strong for particle flux past Chipps Island because large tidal excursions coincided with strong spatial gradients in concentration (Figure 3A).

**Table 5.** Ultimate fate of particles from replicate releases at the Hood site.

Final Location	Inflow	Export	Mean Particles	% of Standard Deviation
Chipps Island	340	57	83.4	0.44
Chipps Island	340	283	15.6	0.57
CVP	340	283	26.9	0.31
SWP	340	283	49.8	0.45
Chipps Island	1,077	170	94.1	0.15
Chipps Island	3,401	170	98.5	0.13

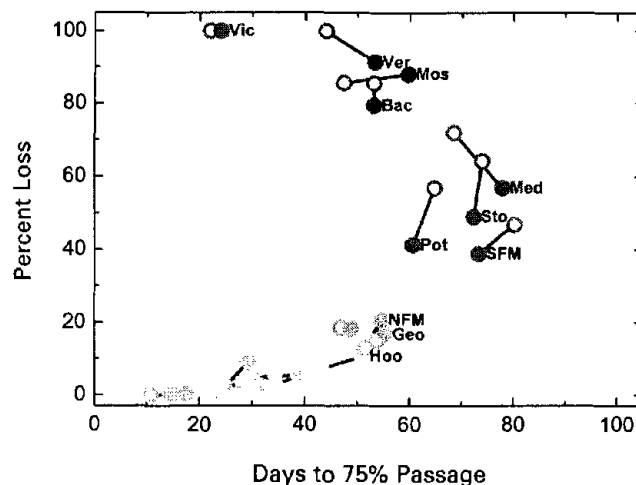
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**Figure 3.** Cumulative passage at Chipps Island and export facilities during low inflow and export flow and spring and neap tides for: A) Releases at Hood and recoveries at Chipps Island, and B) Releases at Vernalis and recoveries at export facilities (top) and Chipps Island (bottom).

Effects in the southern Delta were much less pronounced because of smaller tidal excursions and a longer transit time, which reduced spatial gradients (Figure 3B). Differences between spring and neap tides were most apparent in tidal variability and less so in timing of movement and ultimate fate. The principal effect of spring tides was to spread the particles out, increasing the variety of pathways that they took.

Particle fates on spring and neap tides did not differ markedly (Figure 4). The general trends were for lower losses to export pumping and longer times to leave the Delta on spring tides than on neap tides. The difference in losses was most pronounced in the eastern Delta ( $\sim 10\%$  in some cases), although releases from the southern Delta had high proportional increases in the fraction of particles that left the Delta via Chipps Island. For example, about 9% of the particles released at Vernalis on a spring tide eventually passed Chipps Island, whereas fewer than 1% of the particles did so on a neap tide. The tidal



**Figure 4.** Effect of spring vs. neap tides on time for 75% of particles to leave the Delta vs. the proportion of particles lost to export facilities for low inflow ( $340 \text{ m}^3 \text{ s}^{-1}$ ) and export flow ( $57 \text{ m}^3 \text{ s}^{-1}$ ). Open symbols, neap tide; filled symbols, spring tide; lines connect spring and neap points. Symbol colors represent initial locations as in Figure 1. Labels on some points give release location (see Table 4); others are omitted for clarity.

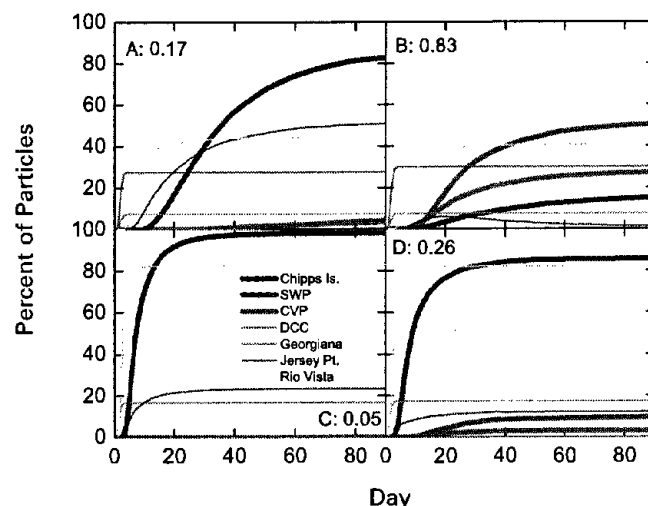
influence on residence time was strongest along the Sacramento and San Joaquin Rivers, and occurred because more particles were mixed into alternative pathways from which they took longer to exit the system. All of these differences were much smaller at higher flow and export levels (not shown).

Subsequent results are for spring tides only, since tide had relatively small effects on the ultimate fate of particles, but could extend residence time in the Delta under some conditions. The influence of net flows in the Delta is illustrated by example model runs from releases at Hood under four contrasting flow conditions (Figure 5). With low inflow and export flow, only about 85% of the particles had left the Delta by the end of the 90-day run (Figure 5A). The passage of particles was delayed by movement of particles into the central Delta, which increased travel time. In contrast, low inflow and high export flow caused most particles to go to the export facilities (Figure 5B). With high inflow, the fate of the particles was determined rapidly, and a smaller fraction entered the central Delta (Figure 5C). Even with high export flow, relatively few particles ended up at the south Delta export facilities if inflow was high (Figure 5D).

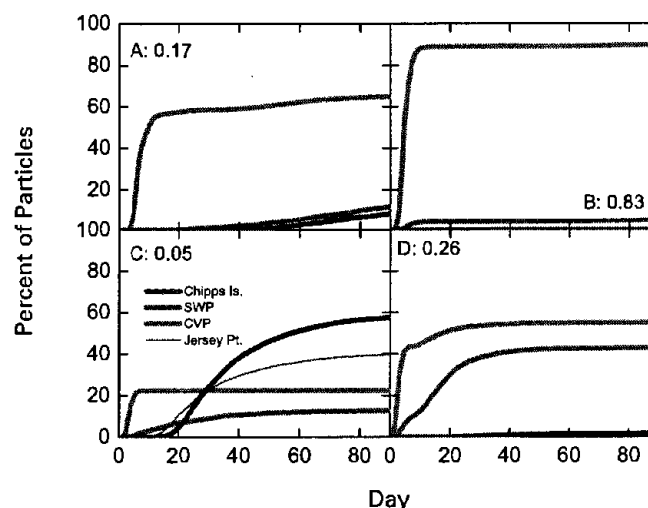
The fate of particles was reversed for releases in the San Joaquin River at Mossdale (Figure 6). There, most of the particles ended up at the export facilities, particularly the CVP, except that high inflows moved a substantial fraction to Chipps Island, and a larger fraction were entrained into the SWP (via the lower San Joaquin River) than was the case with low inflows.

Combining the results of all model runs under spring tides with no agricultural diversions, no agricultural barriers, and the DCC open at flows below  $600 \text{ m}^3 \text{ s}^{-1}$ , we see the predicted effect of flows on the ultimate fraction of particles exported (Figure 7). For each release site, the fraction lost to export flow could be modeled as a logistic function of the export:inflow (EI) ratio. The parameters of the logistic function differed for each site, so that very high EI ratios were necessary to move large fractions of particles from the north Delta to the pumps, whereas only at the lowest EI ratios would substantial fractions of particles from the southern Delta escape entrainment. Variations in fit of the data to the model under high and low flows with similar EI ratios can be seen, for example, in the parallel rows of points for releases at Franks Tract East (Figure 7). These variations suggest that the EI model is not perfect, but no alternative model was found that provided a superior fit to the data.

The above model is over-simplified in that the ultimate fate of the particles can be interpreted only in the context of the time it takes to reach that fate. The day on which 75% of the particles had left the Delta (Figure 8) generally decreased with increasing inflow, reflecting the decrease in hydraulic replacement time with increasing flow (gray lines in Figure 8). In the northern Delta, the 75% time was close to the hydraulic replacement time, whereas in the central and southern Delta it was often much longer. Effects of export flow also varied substantially among release locations. For release sites in the northern Delta, increasing export flow increased net flow and decreased residence time at low inflow. In the central Delta, this effect was reversed at low inflow, because increasing export flow decreased net flow; at higher inflows the effect of export flow in the central Delta was additive as in the northern

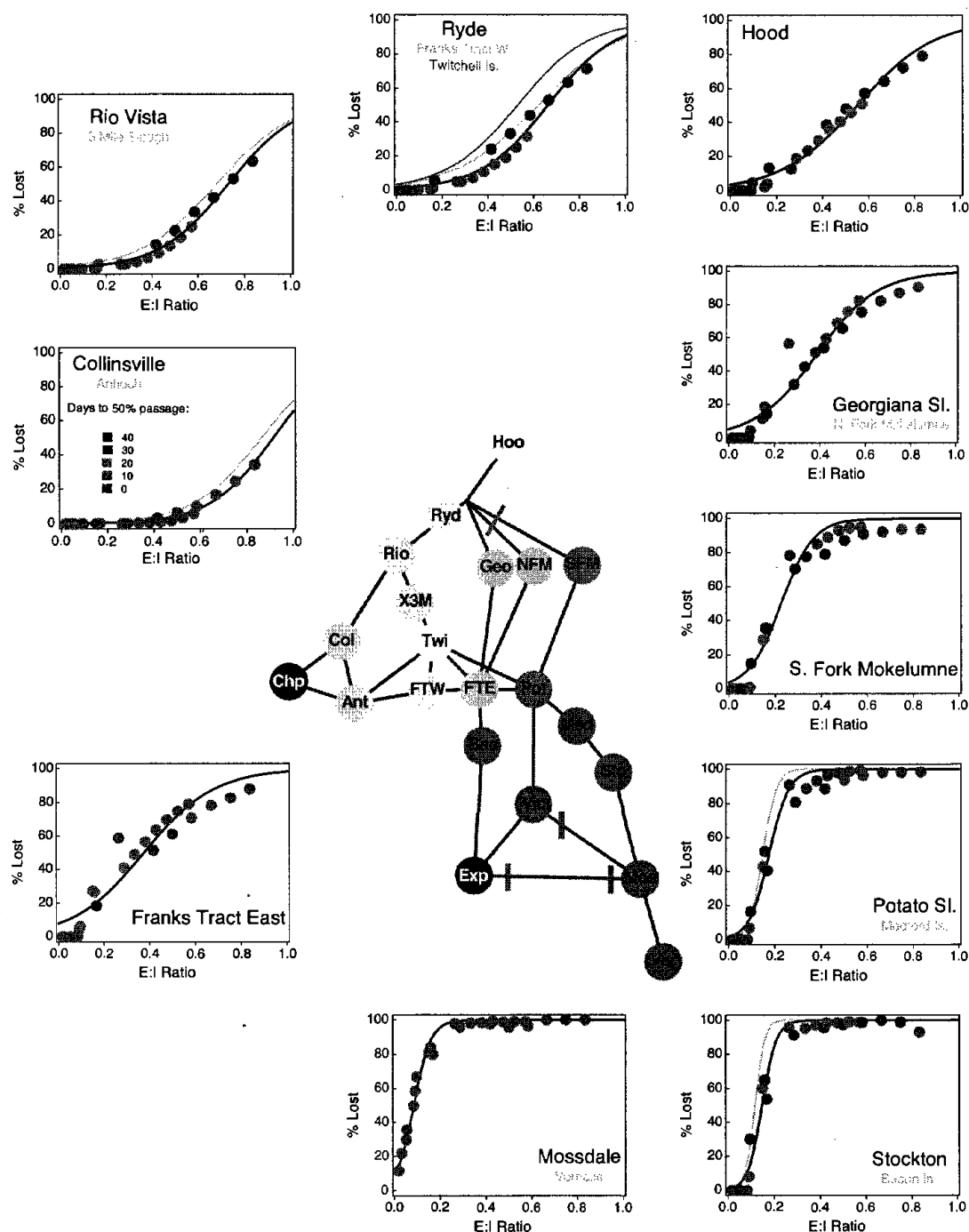


**Figure 5.** Time course of tidally-averaged particle passage for releases from Hood during spring tides for four flow conditions. Thin lines denote intermediate locations, and thick lines denote final locations by which particles leave the model domain (Figure 1). Numbers give export:inflow ratios. A and B have inflow at  $340 \text{ m}^3 \text{ s}^{-1}$ , C and D have inflow at  $1,078 \text{ m}^3 \text{ s}^{-1}$ . A and C have export flow at  $57 \text{ m}^3 \text{ s}^{-1}$ , and B and D have export flow at  $283 \text{ m}^3 \text{ s}^{-1}$ .



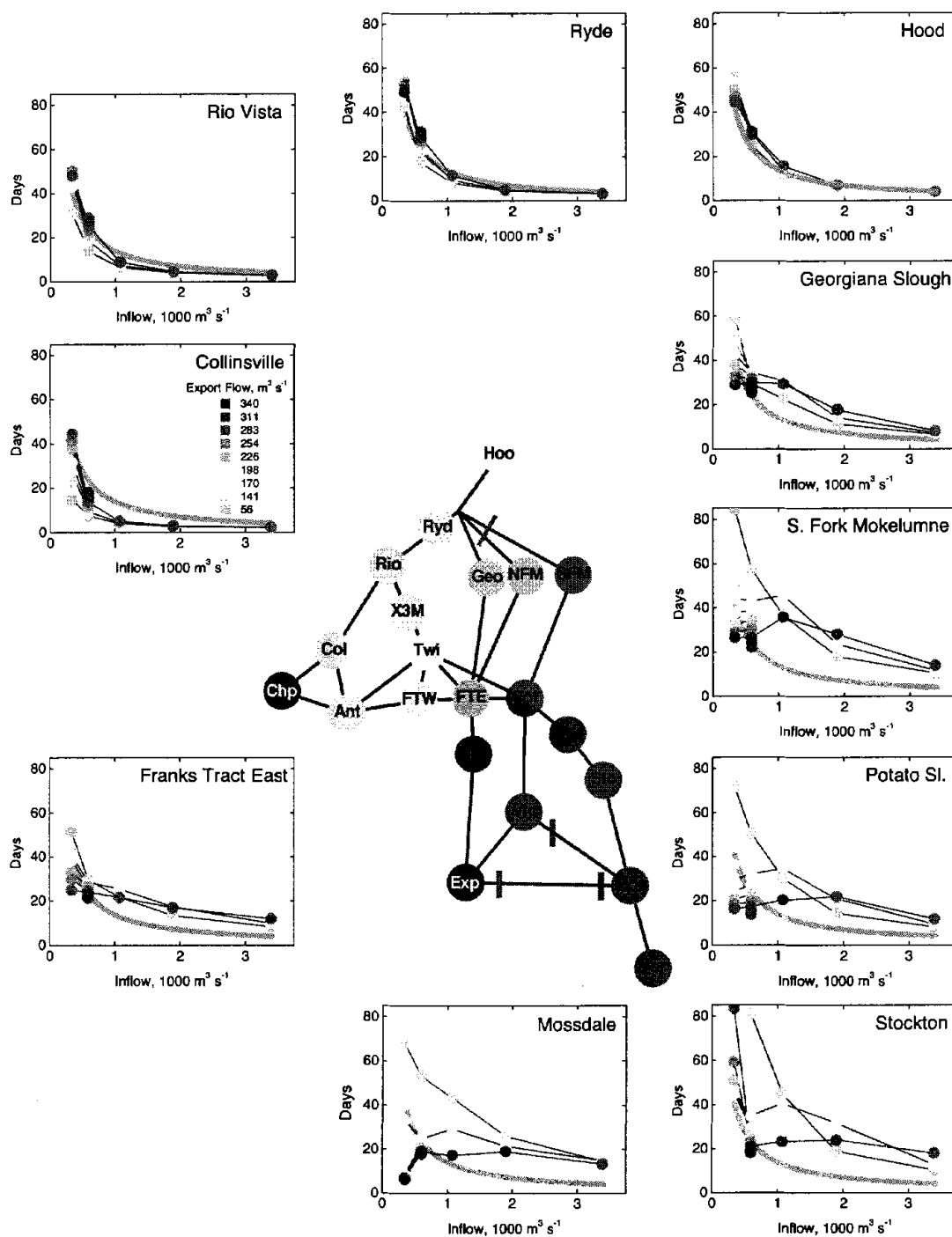
**Figure 6.** As in Figure 5, for releases at Mossdale, intermediate locations include only Jersey Point because few or no particles from Mossdale reached the other intermediate locations.

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**Figure 7.** Percent of particles lost to export pumps for spring tide runs with no agricultural diversions and 24 combinations of inflow and export flow. Data are shown for selected release sites, color-coded by the time needed for 75% of particles to leave the Delta. Lines are logistic functions fit to the data, and are dark for selected sites and light gray for other sites with similar responses. Central diagram is a schematic arrangement of the sites in Figure 1, with principal links between sites. Short lines represent barriers including the DCC in the northern Delta, the Head of Old River barrier in the south Delta (dark yellow), and south Delta agricultural barriers (pink).

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**Figure 8.** Relationship between the time for 75% of particles to exit the Delta and inflow and export flow. Diagramed as in Figure 7. Colors on graphs scale export flow from the lowest (green) to the highest (red). Heavy gray lines give the hydraulic residence time, calculated as the volume of the Delta ( $1.2 \times 10^9 \text{ m}^3$ ) divided by total Delta inflow.

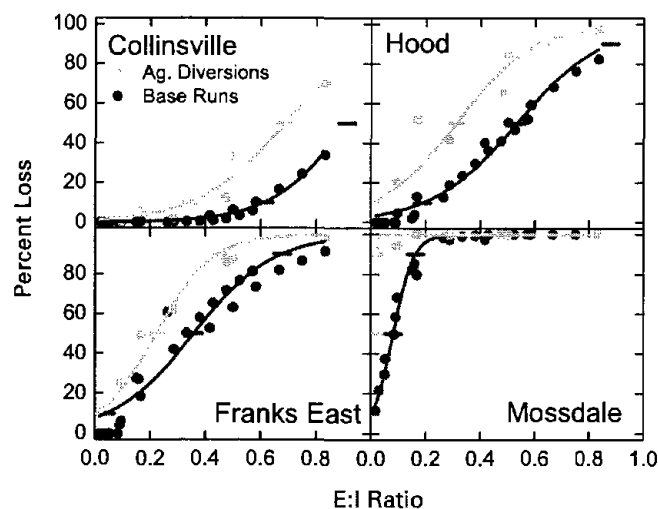
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Delta (e.g., the South Fork of the Mokelumne River, Figure 8). The response of residence time to inflow in the southern Delta was mixed: at low export flow, the response was similar to but much longer than hydraulic replacement time, whereas at high export flow, the effect of inflow was muted or even reversed (e.g., Mossdale, Figure 8).

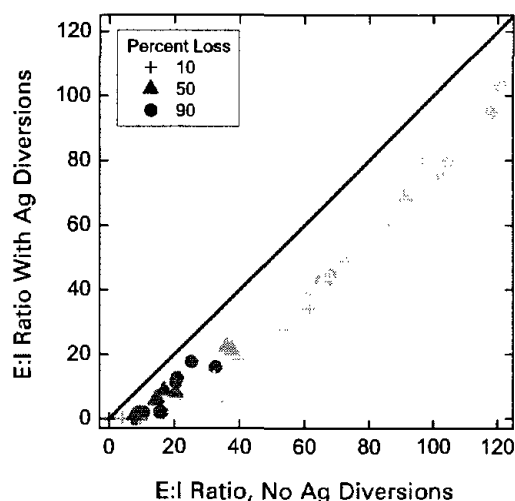
Residence time for releases at Mossdale and Stockton differed in some revealing ways despite the proximity (29 river km) of these two stations. Particles released at Mossdale can enter upper Old and Middle Rivers and go west directly to the export facilities, whereas particles released at Stockton get to the export facilities only by way of the San Joaquin River and southerly net flow in lower Old and Middle Rivers. This means that low inflow and low to moderate export flow can result in long residence times; for example, at the lowest combination of inflow and export flow, the time for 75% of the particles to leave the Delta from Stockton exceeded 90 days (Figure 8).

The effect of agricultural diversions on the fate of particles is rather predictable: higher agricultural diversions increase the proportion of particles lost to total diversions. This has the effect of shifting the logistic curves in Figure 7 to a lower EI ratio (Figure 9) and somewhat decreases the residence time. Combining all results, the EI ratio resulting in a given percent loss decreases predictably across all release sites (Figure 10). The effect of agricultural diversions on the time for 75% of the particles to leave the Delta depends on release site: this time increases for sites in the northern Delta and decreases for sites in the central or southern Delta (Figure 11). This is because the ultimate fates differ: particles released in the northern Delta go mainly to Chipps Island, and are retarded from going there when agricultural diversions reduce outflow. Particles released in the central and southern Delta tend to have high residence times at low flows, but residence times are reduced by losses to agricultural diversions.

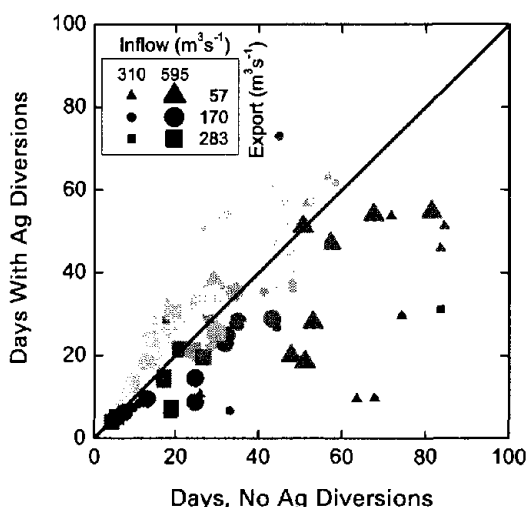
The effect of the Delta Cross Channel on the ultimate fate and timing of particles released in the northern Delta was unexpected (Figure 12). For releases at Georgiana Slough and Ryde, closing the DCC increased the percentage of particles entrained in the



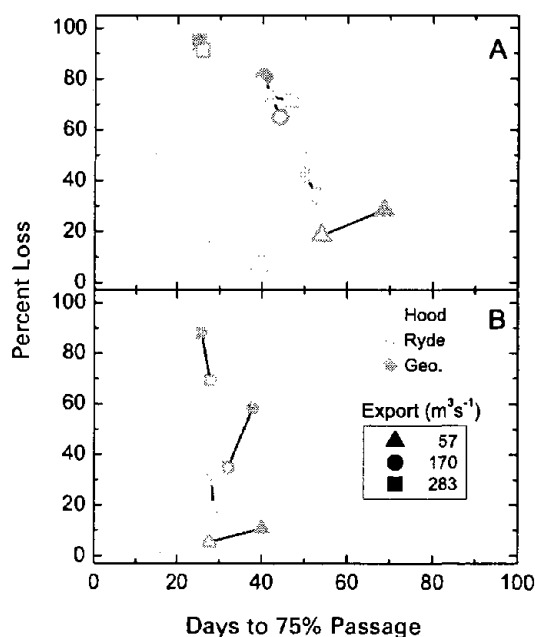
**Figure 9.** Examples of the effects of agricultural diversions. For these four release sites, the relationship of percent of particles lost to the pumps and agricultural diversions is plotted against export:inflow ratio for base runs (shown in Figure 7) and runs with agricultural diversions set to their summer maximum. Short horizontal lines give the quantiles at which export:inflow ratios were calculated for Figure 10.



**Figure 10.** Summary of effects of agricultural diversions for all release sites, showing the required export:inflow ratios for 10, 50, and 90% combined losses to export pumping in the south Delta and agricultural diversions. Each point is derived from logistic curves as in Figure 9. Colors correspond to stations in the diagram in Figure 1.



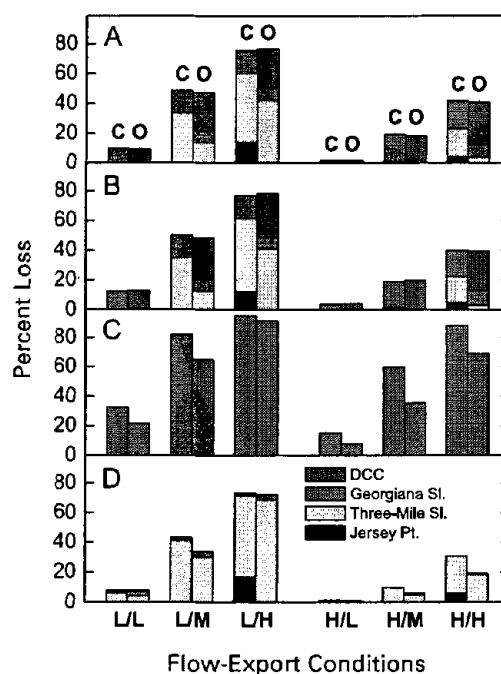
**Figure 11.** Effect of agricultural diversions on the time at which 75% of particles have left the Delta. Symbol colors represent initial locations as in Figure 1. Symbol sizes give inflow in two categories, and shapes give export flow in three categories.



**Figure 12.** Effect of DCC on time for 75% of particles to leave the Delta vs. proportion of particles lost to the export facilities. A) Inflow of  $340 \text{ m}^3 \text{ s}^{-1}$ ; B) Inflow of  $595 \text{ m}^3 \text{ s}^{-1}$ . Open symbols mean DCC open; filled symbols mean DCC closed. The effect of opening the DCC is shown by a line connecting a closed symbol to an open symbol for each set of conditions. Symbol colors represent initial locations as in Figure 1, and shapes give export flow in three categories.

pumping plants and decreased the percentage that passed Chipps Island. For Georgiana Slough, closing the DCC at low export flow rates also increased the residence time of particles. Effects on particle fate were more pronounced at higher flows, while effects on residence time were more pronounced at lower flows.

Closing the DCC alters the pathways of particles from the Sacramento River to the central Delta, but has relatively little effect on overall entrainment except for the release site in Georgiana Slough (Figure 13). Releases at Sacramento and at Hood (Figure 13A, B) had very similar responses. With the DCC closed, about the same proportion of particles was lost to pumping as when it was open; to make up for the loss of the DCC pathway, a greater proportion of particles arrived at the export facilities through Georgiana Slough, Three-Mile Slough at moderate to high export rates, and the lower San Joaquin River at high export rates.



**Figure 13.** Delta Cross Channel effects. Contributions of various pathways to percentage of particles lost to combined CVP and SWP pumping. Each bar gives the contribution of each of four pathways. Release sites were: A) Sacramento; B) Hood; C) Georgiana Slough; D) Ryde (see Figure 1). Flow and export conditions are given in Table 2. C and O in panel A means position of the DCC gates (closed or open) and applies to all panels.

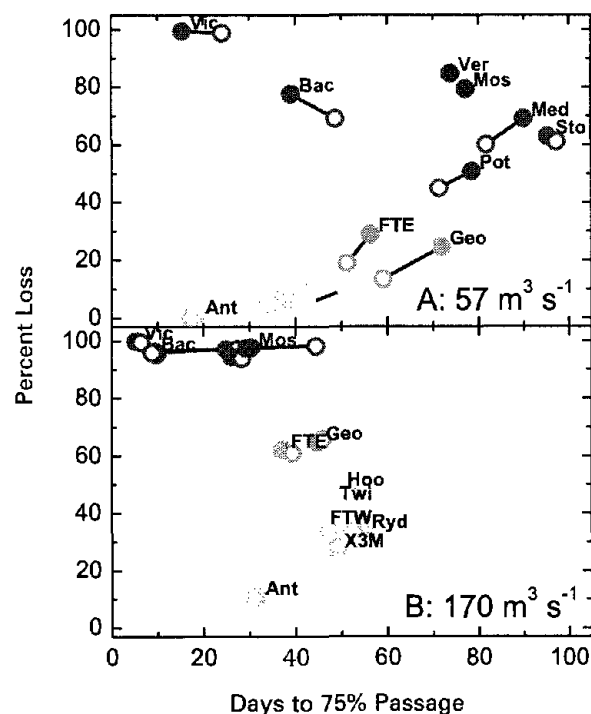
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The temporary barriers in the southern Delta had modest effects on the ultimate fate and residence time of particles (Figures 14–15). Adding the three agricultural barriers (Figure 7) reduced losses from the southern and central Delta at low export rates, and either increased (southern Delta) or decreased (central to northern Delta) the residence time of particles (Figure 14). At higher export rates, the only effect of the barriers was to increase residence time of particles released in the southern Delta. The barrier at the head of Old River (Figure 1) reduced losses by ~20% and increased particle residence time at the lowest export rates; at higher export rates, nearly all of the particles were lost to export pumping, irrespective of barrier position.

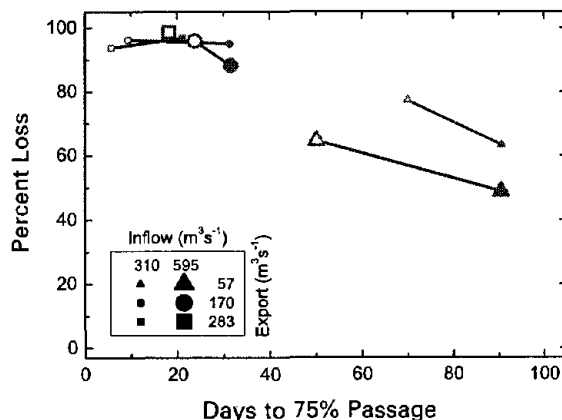
The simulation of delta smelt losses showed substantial cumulative losses could occur under some flow conditions (Figure 16). Losses increased with increasing export flow and with decreasing inflow. The simulation of mark-recapture experiments of Chinook salmon in the northern Delta showed similar results (Figure 17). The ratio of particles passing Chipps Island from releases in Georgiana Slough to those from Ryde increased with inflow, and decreased strongly with increasing export flow, particularly when inflow was low to moderate. The effect of opening the DCC was to increase the predicted recovery ratio (Georgiana Slough:Ryde).

## DISCUSSION

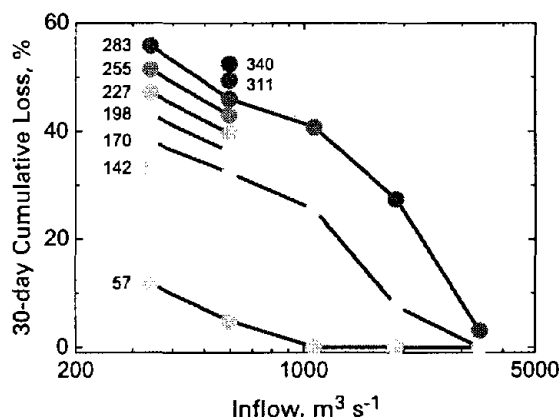
The fundamental assumptions of a particle tracking model (PTM) are that the hydrodynamic representation is reasonably accurate, and the behavior of the particles represents some behavior of interest. DSM2 represents flow and salinity quite accurately (Appendix), reflecting the great effort that has gone into refining the bathymetric data and into calibrating the model to Delta conditions. This has come about mainly because DSM2 is being used as a tool for managing water and for keeping salinity below limits, though it is unfortunate that none of the calibration information has been published and subjected to peer review given this reliance on the model. Thus, we have a reasonable degree of confidence that the basic hydrodynamic and water quality modules pro-



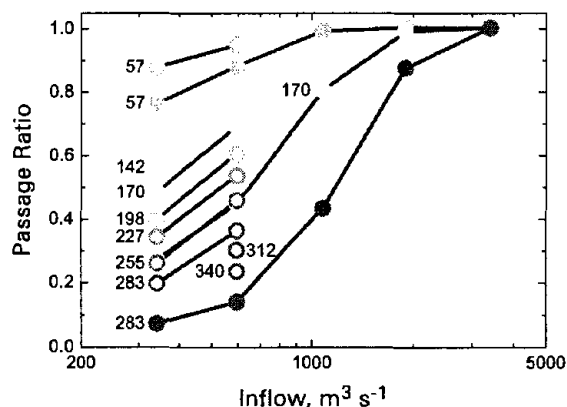
**Figure 14.** Effect of south Delta agricultural barriers on time for 75% of particles to leave the Delta vs. proportion of particles lost to export facilities. Open symbols, barriers absent; filled symbols, barriers in place. Symbol colors represent initial locations as in Figure 1.



**Figure 15.** As in Figure 14 for the barrier at the Head of Old River, releases at Mossdale only; releases at Vernalis have nearly identical patterns.



**Figure 16.** Effect of changing inflow and export flow on modeled fractional losses of delta smelt larvae over a 30-day period. Lines connect data with the same export flow indicated by color. Numbers give export flows.



**Figure 17.** Effect of export flow, inflow, and DCC gate position on the ratio of proportion of particles passing Chipps Island from releases in Georgiana Slough to that for releases at Ryde. Symbols are the same as in Figure 16 except: open symbols mean DCC open; filled symbols mean DCC closed. Numbers give export flows.

vide usable output. However, the PTM has not been calibrated, and it differs enough from the water quality module to suggest caution in interpreting our results. In particular, tidal effects would be most strongly influenced by the method used to track particles through junctions, namely through complete mixing at each junction. This method is less likely to influence advective transport than dispersion, and the results of these model runs suggest advection-dominance most of the time (Figure 4).

The use of PTMs for investigating ecological issues has been increasing (e.g., Garvine et al. 1997; Brown et al. 2005; North et al. 2005). This reflects better hydrodynamic modeling, improved resolution of organism behavior, and greater interest in how organism movement interacts with flow fields. Another stimulus for interest in PTMs is that conceptually they are related to individual-based models (IBMs), and can be considered a simplified case of IBMs. Indeed, IBMs are often embedded as PTMs in models of ocean circulation or mixing (e.g., Batchelder et al. 2002; Hofmann et al. 2004).

Our use of a PTM focuses on life stages of fish with limited mobility, particularly delta smelt larvae, and our region of interest is the entire Delta. We chose not to give particles behavior in these model runs because we had little basis for determining what that behavior should be. Thus, the results presented here may be less applicable to larger, more competent organisms (but see Implications for Chinook Salmon, below).

One striking result of our modeling is that selecting a particular time period, such as the larval period of a fish, gives results that might be easy to interpret for that particular purpose but which will also be difficult to relate quantitatively with environmental conditions. For example, low export flows result in relatively low entrainment from all stations, but they also cause very slow transport through the southern Delta. Thus, a short time horizon might give an optimistically low proportion of particles entrained in the south Delta pumping plants, simply because the particles are still mostly at large in the Delta at the end of the model run. This is why we focused on the ultimate fate of the particles, and used residence time (as

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scaled by the time for 75% of the particles to leave the Delta) as an additional measure.

A consequence of this is that simple questions (e.g., what proportion of particles are entrained under a given set of conditions) have no clear answer. Instead, the answer depends on the time horizon, which in turn depends on the overall flow conditions and the site of the release. We are, furthermore, not inclined to define a "zone of influence" of the pumps on the basis of our results, since the probability of entrainment depends on time horizon which, in many cases, is too long to be useful for analyzing the movements of larval fish. By the end of the modeled time period, the fish would already have metamorphosed, and their behavior would have become more complex.

The export:inflow (EI) ratio proved useful as a predictor of the ultimate fate of particles, subject to several caveats. We were surprised at how well the logistic models of EI ratio fit the data on proportional entrainment (Figure 7), because our working hypothesis was that the EI ratio was too simplistic, and too much based on net, non-tidal flow, to be useful. The EI ratio was useful as a predictor of probability of entrainment, provided the model was allowed to run long enough to resolve the particles' ultimate fate. Over shorter time periods, the EI ratio is less predictive because of the dependence of residence time on overall flow conditions (Figure 8). Furthermore, the relationship of percent loss to EI ratio was logistic, which makes sense given the mechanisms but also requires a nonlinear fit to the data.

The relationship of particle residence time to flow conditions was expected. Hydraulic replacement time (i.e., volume of the Delta divided by inflow) is roughly proportional to the inverse of inflow (Figure 8), and this is reflected in the time for 75% of particles to leave the Sacramento River (where export effects are small). At low inflows, dispersion and export flows have a greater relative impact, so the residence time is shorter than the hydraulic replacement time. In the southern Delta, by contrast, particle residence times were generally much longer, and strongly influenced by export flows. This illustrates a contrast

between the river-dominated northern Delta and the southern Delta where advection is weak and driven largely by export pumping. However, in both regions, net particle movements were largely determined by advection, with tides serving mainly to spread out and delay the passage of particles by the observation points (Figures 3–4).

Agricultural diversions have the effect of lowering the EI ratio needed for a given percentage loss to diversions, i.e., shifting the curves in Figure 7 to the left as in Figure 9. This effect is strongest in the south Delta because entrainment probability is so high under most flow conditions. The effect of agricultural diversions on residence time depends on the initial release site, and varies with inflow and export flow, but would be difficult to predict in general.

## Implications for Chinook Salmon

Salmon smolts are not particles; they have complex behaviors and are strong swimmers. We do not know what cues them to navigate downstream and out to the ocean. However, there are two reasons why PTM results may be informative with regard to salmon. First, whether the fish have strongly directed movement or not, they swim in the channels where they are subject to tidal and residual currents, and thus they will be distributed among alternative pathways during downstream migration, since it seems unlikely that they can distinguish among pathways. Although this distribution may differ from that of the water, it will still result in a dispersive movement pattern. Second, a recent unpublished report on radio tracking of larger yearling Chinook salmon concluded that the movement of the fish could not be distinguished from tidal excursions, and that any seaward-directed movement must be subtle (Vogel 2004). We do not claim that the specific results presented here represent actual movements of salmon; rather, these results indicate what factors may or may not be important in determining how salmon smolts may move through the Delta.

The DCC had smaller effects than anticipated, with virtually no effect on the ultimate fate of particles released upstream of it, and a small effect on residence time. Apparently, closing the DCC gates sim-

ply raises head in the Sacramento River, causing more water and particles to enter the central Delta via other pathways (Figure 13). This contrasts with results of paired mark-recapture experiments with hatchery-reared salmon, which gave a significant effect of gate position in two of three alternative statistical analyses (Newman 2003).

Releases downstream, particularly those in Georgiana Slough, had a greater probability of entrainment in the export pumps when the DCC was closed than when it was open, because of the greater southward net flow in Georgiana Slough and presumably also Three-Mile Slough. Releases at Sacramento and Hood had almost identical fates, indicating that few particles were diverted into Steamboat and Sutter Sloughs to the north of the mainstem Sacramento River, where they would escape entrainment into the central Delta.

Model runs to examine the proportion of particles that arrive at Chipps Island of those released in Georgiana Slough vs. in the mainstem Sacramento River at Ryde showed that both inflow (related to Sacramento River flow) and export flow had important influences. At the highest inflows, the ratio of particle passage was close to 1 (Figure 17). At lower inflows, fewer of the particles released in Georgiana Slough arrived at Chipps Island compared to the Ryde releases, and this effect was stronger at higher export flows. Data from mark-recapture experiments (Brandes and McLain 2001; Newman 2003) gave rather different results for tagged hatchery-reared salmon: most of the survival ratios were low, even when river flow was high (median 0.26 for inflow  $> 1,000 \text{ m}^3 \text{ s}^{-1}$ ; data from P.L. Brandes, U.S. Fish and Wildlife Service, pers. comm.), and survival ratios were only weakly related to export flow and apparently not to inflow or river flow. There are several potential reasons for this difference. It may merely reflect the difference in behavior between salmon smolts and neutrally-buoyant particles. The fish appear to survive poorly in Georgiana Slough, irrespective of flow, possibly because of differences in habitat conditions between the mainstem Sacramento River and the interior Delta (Nobriga et al. 2005). In addition, the recapture rate for the Chipps Island trawl is low and therefore highly variable, and recap-

tures of the fish released in Georgiana Slough may be biased low because the longer migration period results in lower daily recapture rate. Despite all these differences, the PTM results suggest that river flow may be an important variable in determining which way the salmon go and their probability of survival, and should be included in the design and analysis of future studies.

The movable barriers in the southern Delta had a relatively small effect on losses from releases at Mossdale and Vernalis, and a moderate effect on particle residence time. Losses were reduced with the barriers in place, but only at moderate inflow. The barrier at the head of Old River is there to protect salmon from entrainment, but it has little effect on particle fate under flow conditions that result in high entrainment without the barrier.

The Vernalis Adaptive Management Program (VAMP, SJRGA 2006) is intended to reduce entrainment of Chinook smolts migrating down the lower San Joaquin River, and to investigate the influence of alternative river flows and export flows on the survival of marked salmon. The EI ratio typical of the VAMP experimental period is around 10% (as defined here), so entrainment losses should be low (Figures 6C, 7). However, at low flow in the San Joaquin River and low export flow, the time for passage can be very long, with the likely result of higher mortality and lower detection, at least in the Chipps Island trawl survey. Results of the VAMP studies have often shown very low survival for fish released at Mossdale or just below the junctions with Old and Middle Rivers, and relationships of survival to flow conditions appear weak. We believe this is partly because of the small range of inflow and export flow being tested.

### Implications for Delta Smelt

Previous analyses have suggested that delta smelt larvae may be highly vulnerable to export losses (Bennett 2005). Furthermore, the delta smelt population is further seaward and away from the export facilities when freshwater outflow (roughly equal to inflow minus export flow) is high and the salt field is seaward (Dege and Brown 2004). Our PTM results

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suggest a direct link between the position of the smelt population as determined by outflow, and losses as determined by export flow (Figure 16). Results of analyses of larval delta smelt losses are rather similar to those from our PTM studies (Kimmerer 2008). These findings may be enough to recommend strong protective measures for delta smelt in spring (March–May) of low outflow years when they are highly vulnerable to export losses.

We are less confident about estimating entrainment effects on other life stages, since delta smelt appear able to maintain their position in the estuary, generally in brackish water, beginning at the late larval stage. During their spawning migration they are again vulnerable to export effects, but because adult movements may be directed, the PTM is less suitable for analyzing the probability of entrainment of these fish without an improved understanding of adult migratory behavior.

## CONCLUSIONS

This project demonstrates the capabilities and some of the uses of the PTM. The key lesson seems to be the importance of residence time in measuring and interpreting the fate of particles.

Limitations of the model should also be borne in mind. Since DSM2 is calibrated to the existing Delta, it is not a particularly suitable tool for examining alternative physical configurations such as levee failures. It does not represent stratification, does not conserve momentum at channel junctions, and may not represent open-water areas of the Delta very well. However, for examining Delta-wide movements of particles meant to represent fish, these drawbacks appear fairly minor compared with the problem of defining the behavior of the fish. To the extent that fish allow themselves to be dispersed by tidal and river currents, this model is likely suitable for describing Delta-wide movement. This conclusion is contingent upon comparisons of the model with QUAL or, better, 2-D or 3-D model runs, to provide a firmer basis for using DSM2.

Numerous opportunities remain for studies using this model. We examined a limited suite of environmen-

tal conditions, and, in particular, we did not vary the proportions of flow between the Sacramento and San Joaquin Rivers, or between the export facilities. Future studies could also make use of the PTM's capability for assigning behaviors to particles, although 3-D models now becoming available will be much more useful and reliable for that purpose.

## ACKNOWLEDGEMENTS

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## APPENDIX. EVALUATION OF THE CALIBRATION OF DSM2.

Although considerable effort has gone into calibrating, testing, and validating Delta Simulation Model 2 (DSM2), none of this work has been published. Here we compare DSM2 output with field data for stage, flow, and specific conductance. There are no data to calibrate DSM2-PTM directly. The PTM could be tested against the water quality module QUAL for cases of scalar release at several locations, but this has not been done. Thus, the results here should give an indication of how well the hydrodynamic module performs and how well mixing is represented, but there may still be issues with the translation to particle tracking that cause the PTM to be inaccurate.

*Stage and flow:* Model output and data on stage (elevation, m) and flow ( $\text{m}^3 \text{s}^{-1}$ ) at 15-minute intervals were obtained from the Department of Water Resources (C. Enright, pers. comm.). Plots using some of these data are available at <http://www.iep.ca.gov/dsm2pwt/calibrate/Run56vsRun1/index.html>. We selected April 1997 and April 1998 for comparisons because the data were complete for several stations in both time periods.

For each station, year, and variable, we adjusted the model data forward or back in time to obtain the highest correlation to determine how much the model led or lagged the field data. This was always < 1 hour. Regression analysis of the field data against the model gave a slope and correlation coefficient. Correlations, mean differences (data – model), and mean ratios (data:model) were calculated on data averaged by day. A good fit of the model to data would result in a correlation coefficient close to 1, a slope of 1, mean difference of 0, and mean ratio of 1.

In most cases, there was excellent agreement between the model and data (Table A1, example in Figure A1). Correlations of raw data were always close to 1, and correlations of daily-averaged data were almost all > 0.9. Slopes of the regressions (data on model) tended to be somewhat below 1 for stage, while slopes for flow were all between 0.9 and 1.1. Mean differences in stage were substantial in a few cases, notably Jersey Point and Three Mile Slough. Mean differences in flow were usually small in relation to daily means;

the largest mean difference (Jersey Point flow in 1998) was ~10% of the mean of the data. Amplitudes of the model output generally exceeded those of the data by up to 25% for stage, but were within 11% for flow.

Based on these results, the model appears to provide a simulation of stage and flow variability that reasonably represents the field observations. The most obvious deviation between model and data was for stage at two stations. This is probably due to errors in the datum for each of these tidal gages: if these were real errors, the representation of flow would be seriously in error. The other notable discrepancy is in tidal amplitude; the greater amplitude of stage in the model is not reflected in greater amplitude in flow, suggesting that frictional effects may be slightly exaggerated in the model. However, since our interest is in water movement, the accurate representation of flow patterns at all stations is encouraging.

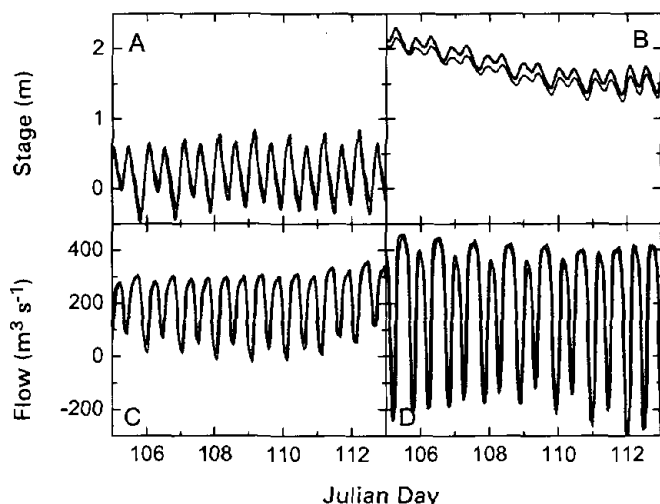
*Salinity:* Model output has been framed in terms of specific conductance rather than salinity. Unlike salinity, specific conductance is not a conservative property and therefore not a clear indicator of mixing. Salinity is defined as a polynomial function of specific conductance that is slightly curved throughout its range. Furthermore, some salinity enters the Delta through agricultural runoff, so at low levels salinity is likewise ambiguous as a tracer of mixing. The result of these sources of uncertainty is that the use of specific conductance for calibrating the QUAL model is most reliable at higher values.

Output from the QUAL module was provided by the California Department of Water Resources (CDWR) as daily means for several nodes from 1990–2006. We downloaded data from the IEP website (<http://www.iep.ca.gov/dss/all/>) from five stations in Suisun Bay and the western Delta that matched QUAL nodes. One of these stations, Three Mile Slough, had an incomplete data record and was not used. The remaining stations had more than one reported value for some days. For example, the Mallard Slough (river kilometer 75) station included five different records, which were either “real-time” or “historical,” the former considered preliminary according to the website. Data were reported at different intervals (daily, hourly, or

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**Table A1.** Summary of calibration data for DSM2 for April 1997 and April 1998. Lag is the number of minutes (15-minute increments) the model output had to be advanced to provide the best fit to the data. The slopes are for  $x$  = lagged model data and  $y$  = observed; 95% confidence limits determined after sampling the data-set to eliminate auto-correlation were 0.02 to 0.04. The daily correlation is based on applying a Godin low-pass filter to remove tidal signals and averaging the data by day, then determining the correlation. The mean difference is data - model, and the amplitude ratio is the mean of the ratio of daily amplitudes in the data to those in the model.

Location	Year	Lag (min)	Correlation	Slope	Daily Correlation	Mean Diff	Amplitude Ratio
<b>Stage (m)</b>							
Jersey Point	1997	0	0.99	0.94	0.95	0.27	0.94
Jersey Point	1998	0	0.99	0.91	0.99	0.25	0.89
Old River	1997	30	0.99	0.84	0.91	0.00	0.85
Old River	1998	15	0.99	0.80	0.98	0.02	0.80
Middle River	1997	30	0.99	0.83	0.90	0.06	0.85
Middle River	1998	15	0.99	0.81	0.99	0.03	0.80
Dutch Slough	1997	-15	0.99	0.97	0.93	0.13	0.97
Dutch Slough	1998	-15	0.99	0.93	0.98	0.05	0.94
Sac. R. above DCC	1997	15	0.98	0.82	0.91	0.01	0.83
Sac. R. above DCC	1998	15	1.00	1.05	1.00	-0.08	0.75
Three Mile Slough	1997	-15	0.99	0.95	0.94	0.18	0.95
Three Mile Slough	1998	-15	0.99	0.89	0.97	0.16	0.88
<b>Flow (<math>m^3 s^{-1}</math>)</b>							
Jersey Point	1997	15	1.00	0.91	0.95	3	0.91
Jersey Point	1998	15	1.00	0.90	0.92	105	0.93
Old River	1997	0	0.99	1.08	0.95	8	1.05
Old River	1998	15	1.00	1.05	0.97	-9	1.04
Middle River	1997	30	0.99	0.98	0.95	8	1.00
Middle River	1998	45	0.99	0.94	0.99	-4	0.98
Dutch Slough	1997	15	0.99	0.98	0.83	3	0.94
Dutch Slough	1998	30	0.99	0.94	0.94	11	0.91
Sac. R. above DCC	1997	45	0.99	1.06	0.99	-14	1.11
Sac. R. above DCC	1998	0	1.00	0.94	1.00	7	1.03
Three Mile Slough	1997	15	0.99	1.02	0.95	-6	1.06
Three Mile Slough	1998	30	0.99	0.94	0.97	-2	0.97



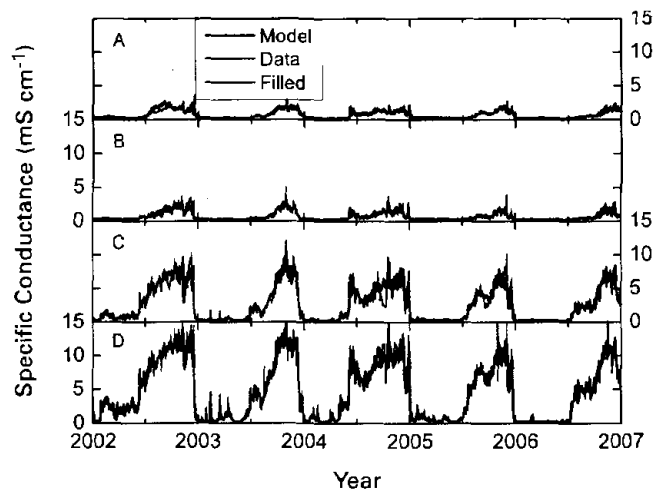
**Figure A1.** Examples of comparison of DSM2 model output (blue) with data (red) from USGS flow-measuring stations, including comparisons with largest time lags and poorest fits. A, B, stage; C, D, flow. A, C, starting date 15 April 1997; B, D, starting date 15 April 1998. A, D, Middle River near DSM2 Node 124; B, C, Sacramento River above the Delta Cross Channel (near Node 341).

every 15 minutes) and from different sources (CDWR, California Data Exchange Center, or U.S. Bureau of Reclamation). Some data were identified as having come from a bottom sensor. Nearly all of these data sources overlapped each other to some degree, and none had a complete record. We selected 2002–2006 for analysis because data were more complete than from other times.

To derive a consensus value for specific conductance at each station on each date, we simply took the medians of all the data for each date. This approach results in some error due to the limited availability of data from the bottom sensors. However, stratification in this part of the estuary is weak most of the time, and inspection of the data showed that field data from different sources were more similar to each other than to the model output. Once medians were calculated, there remained some missing values for all of the stations. These were filled in for each station by first determining which other station was most closely correlated with it, then constructing a generalized additive model with loess smoother (since we had no expectation about the form of the rela-

tionship) and filling in gaps by prediction. From the four stations with 1,827 records each, a total of 220 data points were filled by prediction, and six remaining gaps were filled by interpolation. This gave a complete 5-year record of specific conductance to compare with the model output. This comparison was made by linear regression and also by examining medians and 10th and 90th percentiles of the difference between data and model, and the percent difference.

The comparison of the model with data was generally good (Figure A2). The model tracked the summer high-salinity periods well. Scatter-plots (Figure A3) show how scatter increased with distance from the ocean, and with salinity. These increasing errors reflect, in part, the relatively low values of specific conductance; the possible influence of agricultural runoff at the more landward stations; and, in some cases, obvious spikes in the data that suggest the data are unreliable at those points. In some cases,



**Figure A2.** Time series of model output with measured data for specific conductance at 4 stations in 2004–2006. Model results are complete for the entire time period; measured results are complete except where filled by green lines. Note the difference in scales among stations; maxima in the four panels in terms of salinity (practical salinity scale) are 12, 9, 2.1, and 1.6. Stations are on the Sacramento River at: A, Chipps Island (river kilometer 75); B, Collinsville (river kilometer 81); C, Emmaton (river kilometer 92, halfway between Collinsville and Rio Vista); and D, on the San Joaquin River at Jersey Point (river kilometer 18, ~99 km from the mouth of the estuary).

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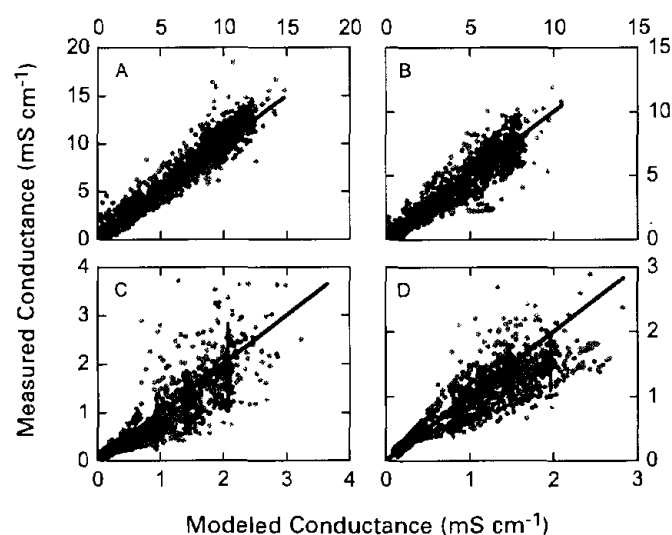
**Table A2.** Summary of calibration data for DSM2 QUAL, daily data for 2002–2006. Locations are shown on Figure 1 except for Emmaton, which is at river kilometer 92, between Collinsville and Rio Vista. Median difference and percent difference are data - model.

Location	Correlation	Intercept	Slope $\pm$ CL	Median with 10th and 90th percentiles	
				Difference	Percent difference
Chippis Island	0.98	20	$1.02 \pm 0.07$	25 (-777 – 1373)	4 (-26 – 49)
Collinsville	0.96	9	$0.97 \pm 0.10$	6 (-808 – 742)	1 (-39 – 39)
Emmaton	0.89	30	$0.85 \pm 0.18$	7 (-403 – 98)	4 (-40 – 29)
Jersey Point	0.91	48	$0.83 \pm 0.13$	7 (-376 – 109)	3 (-32 – 27)

noticeable deviation of the model from the data occurred over a span of time (e.g., at Jersey Point early in summers, Figure A2A). These deviations were more noticeable in drier years (not shown), and could reflect uncertainty in the estimates of Delta outflow and particularly San Joaquin River flow during these periods. These flows are estimated from a water balance that relies on very uncertain estimates of net water consumption in the Delta (<http://www.iep.ca.gov/dayflow/documentation/>).

Consistent with the above observations, the statistical properties of the comparisons declined going from Chippis Island landward to Jersey Point (Table A2; correlation coefficients declined and slopes became flatter). However, the percentage differences between modeled and measured data did not vary much among sites.

These results also support the use of the DSM2 family of models for our particle-tracking work. The good correspondence between model and data in specific conductance means that the model is getting the salt balance about right, implying that longitudinal mixing is reasonably well-depicted. Furthermore, the close correspondence of model output and flow data, particularly the small mean differences in net flow in Table A1, imply that the model depicts net transport with reasonable accuracy.

**Figure A3.** Data in Figure A2 as scatter-plots. Small circles, daily comparisons. Error bars, means with 10th and 90th percentiles of the data binned into 10 equal-size classes of model output and plotted against the model means by class. Straight line, 1:1 line.

## **APPENDIX DOC. 12**

# A Retrospective Estimate of the Economic Impacts of Reduced Water Supplies to the San Joaquin Valley in 2009

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*By Jeffrey Michael, Richard Howitt, Josué Medellín-Azuara, and Duncan MacEwan<sup>1</sup>*

*September 28, 2010*

The effect of reduced water supplies as a result of drought and environmental pumping restrictions in 2009 on the San Joaquin Valley economy was, and continues to be, the subject of significant discussion. Economic effects were quantified in terms of agricultural production, revenues, and jobs and income. In the midst of a severe recession, it is no surprise that job loss estimates generated the most interest and debate. In the months following the 2009 growing season, data have been released that offer a clearer picture of the effects of reduced water supplies. As such, the purpose of this report is to take a retrospective look back at 2009 and summarize changes in agricultural production and employment in the San Joaquin Valley due to reduced water supplies. Model results and survey data now closely coincide and provide conclusive evidence on the final effects of reduced water supplies in 2009.

During 2009, the authors of this report independently issued conflicting estimates of the job losses due to reduced water supplies to San Joaquin Valley agriculture. The varying estimates generated significant controversy. As more reliable data has become available, the differing estimates are converging to a relatively narrow range. By issuing a joint retrospective report, our intention is to provide an accurate range of estimates for policy and planning purposes and place the focus on the similarities rather than the differences.

Before getting to the estimates, it is important to emphasize two additional points on which we agree. First, a significant increase in the amount of water transfers was critically important to reducing the negative impacts of water scarcity. A higher than anticipated level of water transfers is a key reason these revised estimates of losses are smaller than we estimated last year. Building on these successful transfers will be important in minimizing the losses from future

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water shortages. Second, the impacts of reduced water availability were highly concentrated geographically on the west sides of Fresno, Kings, and Kern counties. Although our impact estimates are now lower, they still represent very large losses for these communities in the southwest part of the San Joaquin Valley.

In this report we use two approaches to estimating the economic impact of drought and environmental pumping restrictions on San Joaquin Valley agriculture. We first present the approach conducted by the University of the Pacific which uses the 2009 County Crop Reports<sup>2</sup> (Crop Reports) issued by Agriculture Commissioners of the eight San Joaquin Valley Counties to calculate the change in harvested acres and crop revenue. The 2009 data in the Crop Reports is still preliminary and subject to future revision, but represent the most current official estimates of 2009 crop production. The second approach, conducted by the University of California at Davis, uses the Statewide Agricultural Production Model (SWAP)<sup>3</sup> calibrated exactly in inputs and outputs to a normal water and price year (2005). Using realized water deliveries and transfers in 2009, SWAP estimates changes in agricultural production and revenue resulting from drought and environmental pumping restrictions. The revenue losses are then put into an input-output model to estimate additional employment and income losses in related industries with slight differences in the input-output models used in each approach. In a final step, the impacts are separated into the effects of drought and environmental restrictions, and here the two approaches also differ. Finally, we compare the estimated losses in jobs to those recorded by EDD surveys and the QCEW as context and corroboration for both estimates.

### **Change in Harvested Acres**

Changes in harvested acres reflect the localized effects of drought on San Joaquin Valley agriculture. Counties including Kern, Kings, and Fresno show significant losses while other Counties including Madera, Merced, San Joaquin, Stanislaus, and Tulare show steady or increases in harvested acres between 2008 and 2009 based on Crop Reports. There was also significant variation within Counties, for example, within Fresno County, east-side regions saw little change in harvested acres compared to west-side regions. This is a reflection of both the localized effects of drought and pumping restrictions on regions dependent on State and Federal Project deliveries and/or groundwater pumping.

According to the Water Transfer Database<sup>4</sup> compiled by the University of California at Santa Barbara from water transfers reported in the Water Strategist, there was over 500,000 acre feet of water transferred for agricultural use in 2009. The United States Bureau of Reclamation (USBR) has suggested that this figure may actually be as high as 800,000 acre feet. In addition to water transfers, realized local surface water supplies to east-side Valley regions were higher than

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<sup>2</sup> Available at County Agricultural Commissioner websites. These reports are based on initial surveys that are then compiled and analyzed by NASS, at which point they will become final estimates. The NASS report is not yet available, but can be found in the future at <http://www.nass.usda.gov>

<sup>3</sup> <http://swap.ucdavis.edu>

<sup>4</sup> [http://www.bren.ucsb.edu/news/water\\_transfers.htm](http://www.bren.ucsb.edu/news/water_transfers.htm)

initially anticipated. Higher local surface water supplies and increased levels of groundwater pumping allowed production to shift to relatively water rich regions on the east-side of the Valley. Combined with a shift in cropping pattern to lower water use crops, actual crop losses and land fallowing were lower than originally projected.

**Table 1. Known Water Transfers for San Joaquin Valley Agriculture in 2009**

Transfer (af/yr)	Avg Price/af	Seller	Buyer
7,292	129.75	San Luis & Delta Mendota WA	Westlands Water District
33,420	223.83	San Joaquin River Exchange Contractors WA	Westlands Water District
24,932	161.90	Yuba County Water Authority	Westlands Water District
60,000	33.89	Yuba County Water Agency	California DWR
15,000	39.71	Yuba County Water Agency	SWP Contractors and San Luis & Delta-Mendota WA
16,100	52.95	Yuba County Water Agency	SWP Contractors and San Luis & Delta-Mendota WA
88,900	132.38	Yuba County Water Agency	SWP Contractors and San Luis & Delta-Mendota WA
74,102	145.62	17 entities through Drought Water Bank	9 entities through Drought Water Bank
750	8.07	Ventura County	14 SWP Contractors
1,250	4.03	Ventura County	14 SWP Contractors
216,474	n/a	San Joaquin River Exchange Contractors WA	USBR, San Luis & Delta Mendota WA, and Madera ID
538,220	93.21		

The first approach to calculating change in acreage tabulates change in crop acres between 2008 and 2009 using 2009 preliminary Crop Reports, as shown in Table 2. The entire decline in harvested acres occurred in the three counties most impacted by reduced water deliveries from the Delta and drought: Fresno, Kern and Kings. Across the entire San Joaquin Valley, virtually the entire decline in net harvested acreage was in lower-value field and seed crops as farmers rationally directed more of their scarce water resources to protecting high value fruit and nut orchards. Vegetable production was able to shift north and east from water limited areas on the southwest side of the Valley. In particular, processing tomato production reached record levels in 2009 as processors were very successful in shifting production to new areas. Preliminary crop reports show significant growth in processing tomato, melon and other miscellaneous vegetable acreage in Stanislaus, Merced, and Tulare counties in 2009. Some of the new vegetable acreage was shifted from field crops, but others included new acreage brought into production in response to the drought. In particular, Stanislaus County reported record levels of harvested acres, and conversations with County agriculture officials confirmed that thousands of new acres were planted in 2009 in response to the land fallowing in other areas of the Valley using supplemental water supplies and groundwater.

**Table 2. Change in Harvested Acres Between 2009 and 2008 from County Crop Reports.**

	<b>San Joaquin Valley Total</b>	<b>Fresno, Kings, and Kern Counties</b>	<b>Other San Joaquin Valley Counties</b>
Field Crops	-246,143	-202,824	-43319
Seed	-4,420	-8469	4049
Vegetables	20,482	-21769	42251
Fruit and Nuts	12,462	2150	10312
<b>Total Acres</b>	<b>-217,619</b>	<b>-230,912</b>	<b>13,293</b>

(Note: Harvested acres differs slightly from crop report summaries, because we exclude rangeland and unirrigated pasture land from harvested field crop acres. Source: County Crop Reports available on the website of each Counties' commissioner of agriculture. Other San Joaquin Valley Counties include Tulare, Madera, Merced, Stanislaus, and San Joaquin.)

The one year change in acreage in Table 2 is insightful, but does not tell the full story. First, the Valley experienced three years of drought from 2007 to 2009, and the impact of reduced water supplies was already being felt to some extent in 2008. Comparing 2009 to 2006, the last year of full contract water deliveries, shows a total decline of 256,000 harvested acres in Fresno, Kings and Kern counties, an additional decline of 25,000 acres. Second, although there was no total harvested acreage change in fruit and nut crops, it would be incorrect to assume that there was no loss to these high-value permanent crops. Over the past decade, there has been a rapid increase in permanent crop plantings in Fresno, Kings and Kern counties, particularly almond orchards, and it is likely that fruit and nut acreage would have increased substantially more with full water supplies. Data on almond plantings and recent trends in fruit and nut acreage growth suggest that fruit and nut harvest in the San Joaquin Valley would have increased by an additional 25,000 acres in 2009, mostly almonds. Thus, the first approach estimates roughly 243,000 acres were fallowed due to reduced water supplies to the San Joaquin Valley in 2009. This includes approximately 256,000 fallowed acres in Fresno, Kings, and Kern Counties, and a gain of 13,000 acres in other Counties in response to the shortages elsewhere.

The second approach to estimating change in crop acres uses the SWAP model calibrated to a normal water year with average prices, namely 2005. In light of significant structural changes in agriculture in the San Joaquin Valley between 2006 and 2008, it is also important to consider changes between 2009 and the last normal water and price year. This better reflects the full combined effect of drought and pumping restrictions. We explicitly model the known water transfers (Table 1) and increased east-side water supplies in SWAP. We note that, aside from the updated water data, the model is unchanged from previous reports using this approach. Water transfers account for about 538,000 acre feet of water shifted involving regions in the San Joaquin Valley. Increased east-side water supplies account for an additional 225,000 acre feet.

Table 3 summarizes change in total acres for the total water supply reduction, drought plus environmental pumping restrictions.

**Table 3. Estimated Change in Harvested Acres Due to Drought and Pumping Restrictions in 2009 from the UC-Davis SWAP Model.**

<b>Crop Group</b>	<b>West-side Regions</b>	<b>East-side Regions</b>	<b>Kern</b>	<b>San Joaquin Valley Total</b>
Vegetables	-1,598	-33	-1,018	-2,649
Grain/Cotton	-132,470	-5,298	-62,710	-200,477
Fruit & Nuts	-1,566	-792	-3,415	-5,773
Alfalfa	-11,411	-2,011	-11,497	-24,919
Field	-8,349	-8,865	-10,707	-27,920
Grapes	-380	-171	-2,810	-3,361
Proc. Tom	-2,873	-5	-606	-3,483
<b>Total</b>	<b>-158,646</b>	<b>-17,175</b>	<b>-92,762</b>	<b>-268,583</b>

Preliminary estimates based on remotely sensed satellite images of crop cover estimate that between 260,000 and 290,000 acres were fallowed<sup>5</sup> due to combined water shortages in 2009. The SWAP model calibrated against realized water conditions, as described above, in 2009 yields an estimated 269,000 acres out of production due to drought and environmental pumping restrictions. The results of the model, 269,000, are very close to those estimated using remote sensing data, 260,000. The largest declines are in various field crops, with moderate declines in fruit and nut acreage. However, to the extent that orchards were deficit irrigated during the current drought, there are long term carry over effects on yield which may speed up replanting times leading to additional costs in the future.

The most striking result from analyzing Crop Reports and SWAP model results is the disparity between regions within the San Joaquin Valley. West-side Valley regions show significant losses in harvested acres due to drought and environmental pumping restrictions. In fact, when broken down into more detailed SWAP model regions the difference is even more striking. We return to this effect in the context of revenue losses, in the following section. In contrast, east-side regions show increases, or slight decreases, in acres across the same time frame. This is largely explained by differences in water source between regions, as summarized in Table 4. The west-side of the San Joaquin Valley relies on State Water Project (SWP) and Central Valley Project (CVP) deliveries for over 80% of water in an average water year compared to only 14% for east-side regions. Consequently, in severe drought years and/or with increased environmental pumping restrictions west-side regions and Kern County can be expected to experience relatively higher losses. In the short run, increased groundwater pumping may be a feasible, albeit more costly, solution to replace reduced water supplies. However, during drought and pumping restrictions over several years, as was the case from 2007-2009, this may draw down the water table which increases pumping costs and leads to long term water quality considerations.

<sup>5</sup> Personal communication with David's Engineering, Davis, CA. September 27, 2010.

**Table 4. Water Supply Proportion in an Average Water Year for San Joaquin Regions**

<b>Region</b>	<b>CVP and SWP</b>	<b>Local Surface Water</b>	<b>Groundwater</b>
East-side	14.80%	52.60%	32.60%
West-side	85.05%	4.96%	9.99%
Kern	57.27%	12.92%	29.81%

### Change in Agricultural Revenues

Changes in agricultural revenues due to drought and environmental pumping restrictions follow directly from changes in harvested acres. As such, they also reflect the localized effects of drought on San Joaquin Valley agriculture. We summarize changes in agricultural revenues using the two approaches in this section.

The first approach, using Crop Reports, is detailed in Table 5. Crop losses are valued using typical 2008 prices to allow for comparisons and to be consistent with the base year of the economic impact model in the next section. Cotton and grain production experienced the largest acreage declines, followed by other field crops, most of which is silage. Most of the lost nut and fruit acreage was allocated to almonds which yielded an average of \$3,500 per acre in 2008. Because vegetable acreage substantially increased in San Joaquin Valley as a whole in 2009, no vegetable production is included. For the entire San Joaquin Valley, the \$342.6 million decline is 2.3% of total crop production exceeding \$15.1 billion in 2008.

**Table 5. Estimated Acreage and Revenue Losses due to Reduced San Joaquin Valley Water Supplies from County Crop Reports.**

<b>Crop</b>	<b>Decrease in Harvested Acres</b>	<b>Per acre value</b>	<b>Revenue Loss</b>
Cotton	-70,000	\$1,400	-\$98,000,000
Alfalfa Hay	-25,000	\$1,500	-\$37,500,000
Other field crops	-53,000	\$1,200	-\$63,600,000
Grain	-70,000	\$800	-\$56,000,000
Nuts and Fruit	-25,000	\$3,500	-\$87,500,000
<b>Total</b>	<b>-243,000</b>		<b>-\$342,600,000</b>

(Per acre values are set at typical 2008 prices for consistency with the input-output model, and to separate water effects from the large 2009 decline in field crop prices partially due to the dairy crisis.)

The second approach uses the SWAP model, with realized water deliveries in 2009, to estimate total change in agricultural revenue by region and crop. The water scenario is the same as that used in May 2009, and a subsequent update in September 2009. The scenario reflects the final, actual, water deliveries to the San Joaquin Valley 2009. Specifically, 10% CVP agricultural water service contract, 100% for all Settlement and Exchange regions, 100% Friant Class 1, 0%

Friant Class 2 and 40% SWP. The only change to the model is to allow for water transfers and increased east-side local surface water supplies, as discussed previously.

Change in agricultural revenue due to drought and pumping restrictions is summarized in Table 6. All dollars are reported in \$2008. We estimate that \$368 million was lost due to drought and pumping restrictions across the entire San Joaquin Valley. This represents a 2.5% decline in revenue<sup>6</sup> across the entire San Joaquin Valley. Of the \$368 million in losses, \$328 million (89%) is in Kern and the west-side regions.

As discussed in the acres section, there is significant variation in changes in revenue across regions in the San Joaquin Valley. West-side regions that are more reliant on State and Federal Project deliveries realize higher fallowing, and thus higher revenue losses than east-side regions. Additionally, regions adjust water use by shifting cropping patterns to lower water use crops. Finally, stress irrigation and increased groundwater pumping in west-side regions can have long term effects on yields, water quality, and revenues in the future. To the extent that these are not included, these cost estimates represent a lower bound.

**Table 6. Estimated Change in Revenues Due to Drought and Pumping Restrictions in 2009 from UC-Davis SWAP model. (dollar values in thousands).**

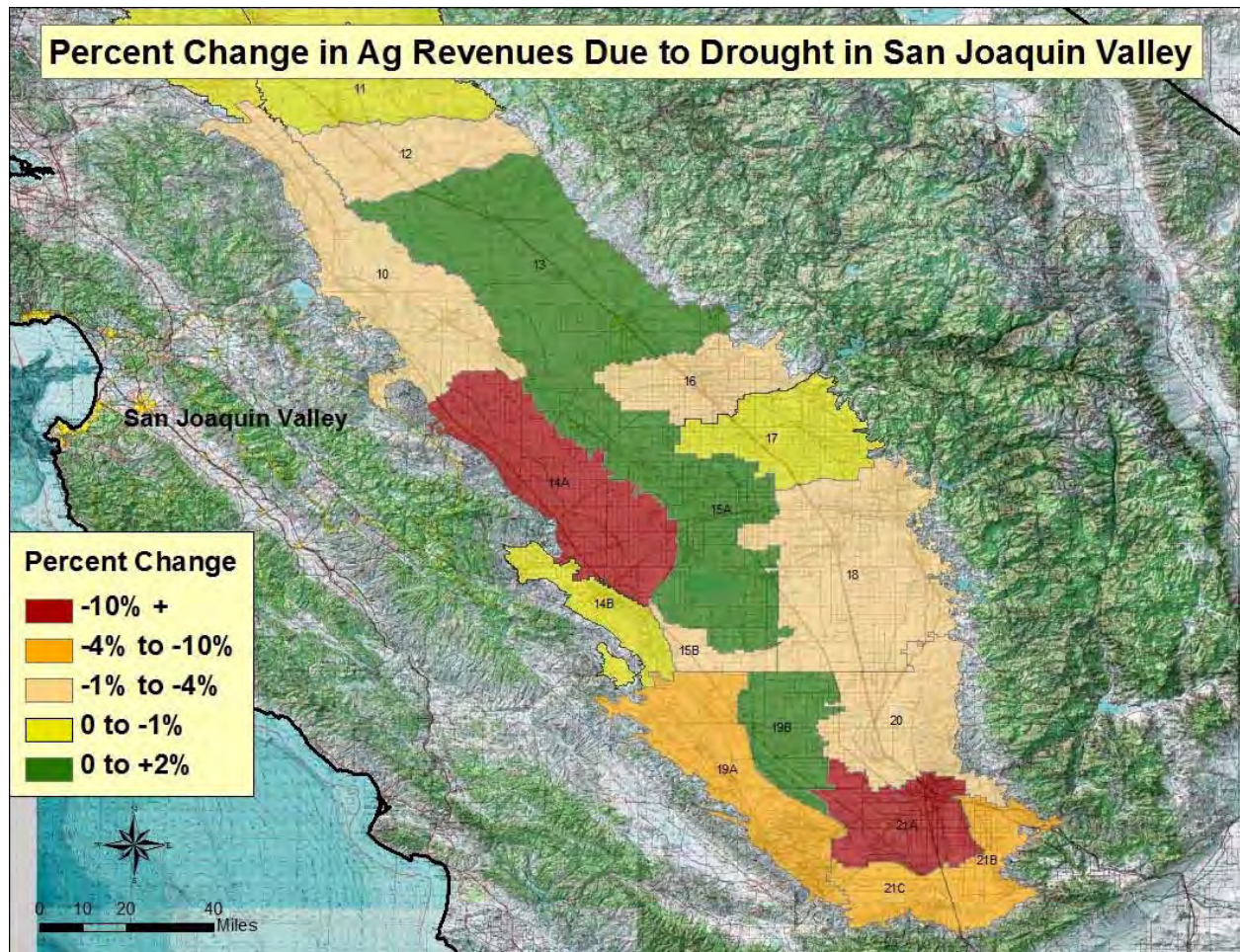
<b>Crop Group</b>	<b>West-side Regions</b>	<b>East-side Regions</b>	<b>Kern</b>	<b>San Joaquin Valley Total</b>
Vegetables	-\$9,487	-\$446	-\$6,654	-\$16,587
Grain/Cotton	-\$149,085	-\$12,813	-\$52,098	-\$213,996
Fruit & Nuts	-\$14,455	-\$9,973	-\$30,447	-\$54,874
Alfalfa	-\$13,159	-\$6,674	-\$16,231	-\$36,065
Field	-\$5,370	-\$8,651	-\$4,499	-\$18,519
Grapes	-\$1,799	-\$347	-\$13,396	-\$15,542
Proc. Tom	-\$10,850	-\$36	-\$1,616	-\$12,502
<b>Total</b>	<b>-\$204,204</b>	<b>-\$38,939</b>	<b>-\$124,940</b>	<b>-\$368,084</b>

To illustrate the importance of regional differences for the effects of drought and pumping restrictions, Figure 1 shows a map of revenue changes in the San Joaquin Valley. The largest revenue losses are concentrated in Kern County and west-side Valley Regions. However, it is important to note that there is significant variation within Counties which is not captured when analyzing County level survey estimates and Crop Reports. For example, within Fresno County west-side regions, specifically Westlands Water District, realize losses in revenue over 10% whereas the east-side of the County sees unchanged to slightly positive revenue growth. The west-side of Fresno County relies heavily on SWP and CVP deliveries, which are cut significantly under drought and pumping restrictions. The same is true within Kern County

<sup>6</sup> Note, total SWAP output value for the San Joaquin valley is 13.6 billion dollars. SWAP model regions are agronomic regions that may omit agriculture in fringe areas of some Counties, which accounts for approximately \$800 million in omitted agriculture.

where regions with relatively higher groundwater availability realize small increases in revenues compared to regions dependent on Project deliveries which see declines in revenue up to 14%.

**Figure 1. Map of Percent Change in Agricultural Revenues Due to Drought**



### Change in Agricultural Employment

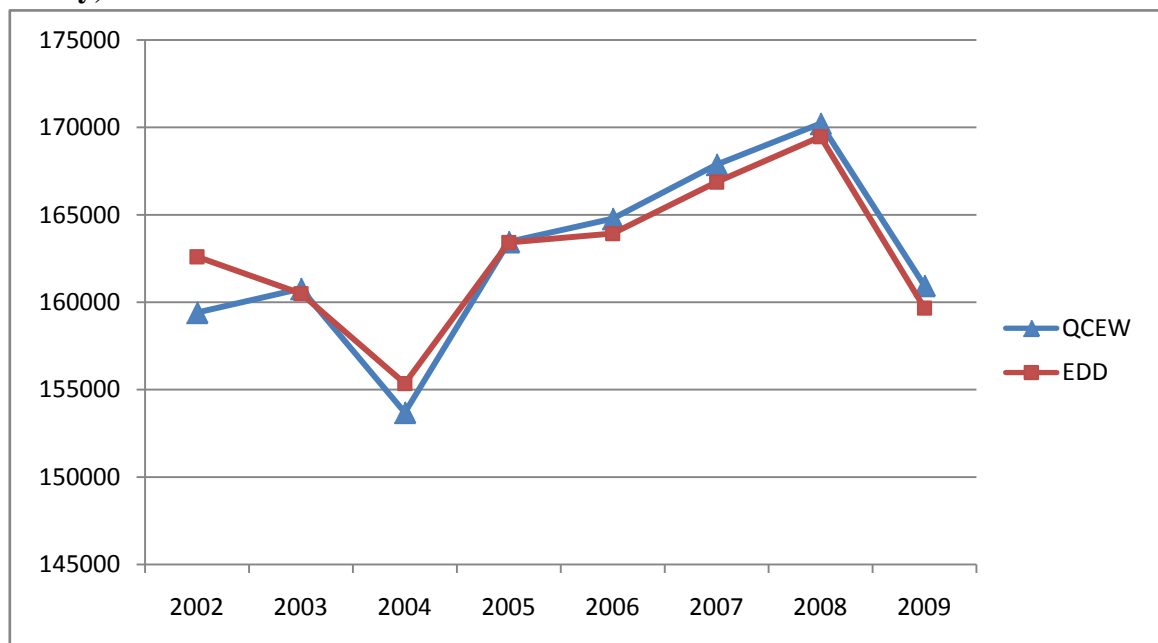
Before estimating the effect of drought and environmental pumping restrictions on agricultural employment, we summarize the actual total change in agricultural employment in the San Joaquin Valley during the drought. There are many factors, including water availability, that cause agricultural employment to change from year to year. The total changes in employment put the subsequent estimates into context and demonstrate that they are of a reasonable scale.

Two sets of highly reliable data are now available to examine the total change in agricultural employment in the San Joaquin Valley between 2008 and 2009. The California EDD has finalized its 2009 agricultural employment survey results and the QCEW is a census of jobs from

unemployment tax filings of agricultural employers. Both sources are more accurate than the employment estimates released each month by California EDD that initially showed an increase in farm jobs in 2009. In order to focus more closely on crop production, we exclude direct employment from Animal Production enterprises (NAICS 112) and show the sum of Crop Production employment (NAICS 111) and Support Activities for Agriculture (NAICS 115) which is primarily farm labor contractors. Animal Production enterprises also hire contract labor, but Crop Production accounts for the vast majority of contract labor. Thus, this focus reduces, but does not completely eliminate, the influence of animal operations such as dairy farms on employment levels.

Figure 2 graphs the two data series between 2002 and 2009, the years for which both have consistent data. Both data sources track closely over time. Between 2008 and 2009, employment decreased by nearly 9,800 jobs (5.8%) in the EDD data and decreased by 9,300 (5.5%) in the QCEW data. When 2009 is compared to the last normal water and price year, 2005, jobs decline by 3,750 (2.3%) in the EDD data and 2,500 (1.5%) in the QCEW data. This data suggests that reasonable estimates of water-related employment loss should be between 2,500 and 9,800 lost jobs. The next section shows that the estimates from both approaches fall within this range.

**Figure 2. Crop Production and Agricultural Support Employment in the San Joaquin Valley, 2002-2009.**



### Estimating Change in Employment Due to Drought and Pumping Restrictions

The impact of the lost agricultural revenue on jobs and income in the San Joaquin Valley can be calculated with an input-output model. The IMPLAN model is used to translate a change to final sales or output from farms into total jobs, income and output within the region. The impact on

jobs, income, and output are categorized as direct, indirect, and induced effects. Direct effects are the changes in employment to direct farm employees, and direct changes to income from farm employee compensation, farm proprietor income, and other farm income. Indirect effects represent the iterative impacts from farms' purchase of intermediate inputs such as fuel, chemicals, transportation services, accounting and professional services, and labor supplied by agricultural labor contractors. Induced effects reflect local household consumption expenditures of direct and indirect sector employees. Examples of induced effects include employee's local expenditures on retail goods, housing, restaurants, recreation, medical services, and other goods and services. Output measures total final sales of businesses within the region and therefore double-counts some expenditures, whereas income measures value-added at each level of economic activity. Although it is a useful measure of economic activity, output is not directly comparable to commonly cited value-added based measures of the economy such as Gross State Product. Income is a preferable measure of the change in regional economic welfare within a region, and facilitates comparisons to other economic data.

The University of the Pacific analysis utilizes IMPLAN 3 and 2008 base data to create an input-output model for the eight counties in the San Joaquin Valley. IMPLAN 3 is the most recent update to the software, and the 2008 base economic data is used to be consistent with the 2008 agricultural prices used throughout the report. Although data in the IMPLAN model is calibrated to local conditions in the base year, the industry production functions are based on historical national averages and require some adjustments to capture San Joaquin Valley agriculture's unusually heavy reliance on contract labor. For example, in 2008, direct employment on San Joaquin Valley crop farms averaged 65,000, whereas the agricultural support services sector averaged 105,000 jobs primarily with farm labor contractors. In contrast, crop farms in California outside the San Joaquin Valley directly employed 110,000 workers, and there were only 74,000 agricultural support services jobs in these areas. If we used the IMPLAN default production functions, only about half of the 105,000 agricultural service workers in the Valley would be hired by San Joaquin Valley farms, so we increased contract labor purchases across crop sectors until the regional farm sector used all the agricultural service workers in the region. We also made some minor adjustments to direct employment by detailed farm sector to match the published estimates for 2008 from the California EDD and Department of Food and Agriculture. These adjustments cause our estimates of lost employment and income to be considerably larger than if we had utilized the IMPLAN models default levels, but the results more accurately describe local conditions and more closely match the data on actual employment losses. UC Davis employs IMPLAN Version 2.0 and the California County database for the base year 2006. The ten IMPLAN default crop categories were grouped into six crop groups to better reflect SWAP output, namely: grain, vegetable and melon, tree nut, fruit, cotton and all other crops. As discussed in the preceding paragraph, the default IMPLAN production functions do not reflect current conditions in California. Consistent with previous analysis by UC Davis, we adopt a different approach than that of University of the Pacific to adjust the IMPLAN model. We modified the default IMPLAN production functions coefficients to match the reported

proportion of contracted labor (as agricultural services NAICS 115) in the EDD 2006 breakdown of agricultural employment. Overall, the coefficient change was slightly less than double the default value. We allow the production function to then re-balanced using the IMPLAN default algorithm. No additional adjustments were used.

## Results

Using the Crop Report data, the University of the Pacific approach estimates a total of \$342.6 million in revenue losses across the San Joaquin Valley due to drought and pumping restrictions. Table 7 shows the impact of the \$342.6 million decline in San Joaquin Valley agricultural output (from Table 5). Total job loss, including, all multiplier effects totals 5,567. The indirect effects include approximately 2,850 agricultural services jobs, so the total job loss of 5,567 breaks down to 4,515 agricultural jobs and 1,052 non-agricultural jobs. Total lost income is \$287 million which includes an estimated \$136.3 million in employee compensation and \$150.7 million in non-employee farm income. The \$342.6 million decline in farm output resulted in an additional \$243.2 million decline in regional economic output for a total output decline of \$585.8 million.

**Table 7. San Joaquin Valley Impact of Reduced Water Supplies based on a \$342.6 million decline in output estimated from Crop Reports.**

<b>Impact Type</b>	<b>Employment</b>	<b>Income</b>	<b>Output</b>
Direct Effect	-1,663	-\$145,787,345	-\$342,600,000
Indirect Effect	-3,096	-\$89,179,500	-\$142,944,720
Induced Effect	-808	-\$52,010,240	-\$100,230,032
<b>Total Effect</b>	<b>-5,567</b>	<b>-\$286,977,005</b>	<b>-\$585,774,720</b>

Using results based on the SWAP model, the University of California at Davis approach estimates a total of \$368.1 million in lost agricultural revenues due to drought and pumping restrictions (see Table 6). Table 8 shows the impact of the \$368.1 million decline in agricultural output in the San Joaquin Valley. Total job loss, including, all multiplier effects totals 7,434. Total income loss is estimated at \$278 million with a \$796 million decrease in output.

**Table 8. San Joaquin Valley Impact of Reduced Water Supplies based on SWAP Model Results of \$368.1 (2008) million decline in agricultural revenues.**

<b>Impact Type</b>	<b>Employment</b>	<b>Income*</b>	<b>Output</b>
Direct Effect	-2,117	-\$90,700,000	-\$359,300,000
Indirect Effect	-2,823	-\$75,000,000	-\$152,300,000
Induced Effect	-2,494	-\$113,000,000	-\$284,400,000
<b>Total Effect</b>	<b>-7,434</b>	<b>-\$278,700,000</b>	<b>-\$796,000,000</b>

\*As total labor income.

## Breaking Down the Effect of Drought and Environmental Pumping Restrictions

Thus far we have used two approaches to estimate the change in acreage, revenues, and jobs and income due to the combined effects of drought and environmental pumping restrictions in the San Joaquin Valley. Equally as important is the proportional effect of drought and pumping restrictions, considered separately. In this section we provide an estimate of the percent of economic losses attributable to pumping restrictions which differ from share of water supply lost to pumping restrictions.

The first approach, conducted by the University of the Pacific, is to allocate 25% of economic losses to pumping restrictions and 75% to drought in proportion to their average relative contribution to reduced water deliveries. This simple approach does not take a stance on whether the drought is an incremental impact on the environmental restrictions or whether the environmental effects are incremental to the drought. Table 9 shows the allocation of losses between the two causes. The effect of environmental pumping restrictions is estimated at 1,392 lost jobs, a \$71.7 million decline in income, and a \$146.4 million decline in output.

**Table 9. Relative Impacts of Drought and Pumping Restrictions based on decline in output estimated from Crop Reports, and proportional changes to economic losses and water supplies.**

<b>Impact Type</b>	<b>Employment</b>	<b>Income</b>	<b>Output</b>	<b>Acres</b>	<b>Revenue</b>
Drought	-4,175	-\$215,232,754	-\$439,331,040	-182,250	-\$256,950,000
Pumping Restrictions	-1,392	-\$71,744,251	-\$146,443,680	-60,750	-\$85,650,000
<b>Total Effect</b>	<b>-5,567</b>	<b>-\$286,977,005</b>	<b>-\$585,774,720</b>	<b>-243,000</b>	<b>-\$342,600,000</b>

The second approach, conducted by UC Davis, runs two scenarios in the SWAP model, one with drought only and one with drought and environmental pumping restrictions. In contrast to the University of the Pacific approach, this allows for modeling the shift in cropping pattern and production across regions with and without pumping restrictions. As such, this captures the marginal adjustments by farmers in response to pumping restrictions and the allocation of effects is not a strict percentage across all categories. The effect of pumping restrictions on San Joaquin Valley agriculture depends solely on the amount of water restricted for delivery, which depends on the type of water year. In average and wet years, pumping restrictions account for a higher total amount of water reductions relative to drought years. This is a function of both the legal aspects of the Wanger ruling and the fact that in wet and average years there is more water available, thus it is feasible to allocate more to fish without damaging agriculture. It's estimated that pumping restrictions account for 500,000 af in a critical year and up to 2,000,000 af in wet years. Since 2009 was a dry year, we attribute 500,000 af of reduced water supplies due to environmental pumping restrictions.

Table 10 summarizes the results of the two SWAP model runs. The total effect is estimated at \$368 million in lost revenues, 7,500 jobs, and 268,000 fallowed acres. The drought alone accounts for \$222 million in revenue losses which translates into 4,400 jobs lost including 1,300 direct and 3,100 indirect and induced. Under drought only, an estimated 138,700 acres are fallowed. We estimate that environmental pumping restrictions accounted for \$146 million in lost agricultural revenues in 2009, representing 39% of the total combined effect of reduced water supplies. Additionally, of the estimated 7,500 jobs lost 3,000 can be attributed directly to pumping restrictions for fish, representing 40% of total agricultural jobs lost due to reduced water supplies in 2009. Finally, of an estimated 268,500 fallowed acres, 129,800 can be attributed directly to pumping restrictions, representing 36% of total fallowing.

**Table 10. Relative Impacts of Drought and Pumping Restrictions based on decline in output estimated from SWAP.**

<b>Impact Type</b>	<b>Employment</b>	<b>Income</b>	<b>Output</b>	<b>Acres</b>	<b>Revenue</b>
Drought	-4,460	-\$166,900,000	-\$477,200,00	-138,700	(\$222,000,000)
Pumping Restrictions	-2,973	-\$111,800,000	-\$318,800,000	-129,800	(\$146,000,000)
<b>Total Effect</b>	<b>-7,434</b>	<b>-\$278,700,000</b>	<b>-\$796,000,000</b>	<b>-268,500</b>	<b>(\$368,000,000)</b>

## Conclusion

This report conducted a retrospective look at 2009 to estimate the total effect of reduced water supplies due to drought and environmental pumping restrictions for agricultural regions in the San Joaquin Valley. Economic impacts were summarized in terms of change in acres, revenues, employment, and income for San Joaquin Valley. No attempt was made to quantify the long term effects of groundwater overdraft, stress irrigation, or rotational adjustments due to the prolonged drought. To the extent that these effects are important, all estimates in this report represent lower bounds on total economic impacts.

This report considers two approaches to estimate the total economic impacts of drought and water pumping restrictions on San Joaquin Valley agriculture. The approaches and the results they yield are similar in many ways, but there are three significant differences. The first approach conducted by the University of the Pacific utilized County Crop Reports to estimate the decrease in agricultural production, and allocated impacts between drought and environmental pumping restrictions. The second approach, conducted by UC Davis, uses the Statewide Agricultural Production Model (SWAP) calibrated exactly to an average water and price year to estimate changes in agricultural production due to realized water deliveries and water transfers in 2009. This approach also uses the SWAP model to estimate changes in agricultural production attributable to drought alone and environmental pumping restrictions alone. Both approaches also use slightly different input-output models to estimate total economic impacts including indirect and induced effects. The results of both approaches were compared to direct measures of agricultural employment change to ensure consistency and reasonableness. Table 10

summarizes the total economic impact on the San Joaquin Valley of reduced water supplies for agriculture in 2009. Table 11 summarizes the portion of the total impacts attributable to the environmental restrictions on Delta water pumping.

**Table 10. Total Economic Impact of Drought and Pumping Restrictions on San Joaquin Valley Agriculture in 2009.**

	Pacific	UC-Davis
Fallowed Acres	243,000	269,000
Agricultural Revenue	-\$342,600,000	-\$368,084,000
Employment	-5,567	-7,434
Income	-\$286,977,005	-\$278,700,000
Output	-\$585,774,720	-\$796,000,000

**Table 11. Total Economic Impact of Pumping Restrictions on San Joaquin Valley Agriculture in 2009.**

	Pacific	UC-Davis
Fallowed Acres	61,000	129,800
Agricultural Revenue	-\$85,650,000	-\$146,000,000
Employment	-1,392	-2,973
Income	-\$71,744,251	-\$111,800,000
Output	-\$146,443,680	-\$318,800,000

To conclude we want to emphasize the importance of regional differences within the San Joaquin Valley and even within specific Counties. At the County level, Fresno, Kings, and Kern are the most significantly affected by drought and pumping restrictions in terms of fallowed acres, lost revenue, and lost jobs. However, even County level data masks some of the regional differences. Agronomic regions within Fresno County realize revenue losses ranging between 1.5% growth, in the East-side of the County, to over 10% declines, in Westlands Water District. These differences indicate a strong economic gradient and emphasize the importance of water markets for mitigating the localized effects of reduced water supplies. Looking forward to 2011, early

weather predictions are attributing a high probability to another dry year. Following dry years in 2006-2009 and with increased attention on Delta exports, California agriculture faces significant challenges.

## **APPENDIX DOC. 13**

## San Luis & Delta-Mendota Water Authority



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## State Water Contractors, Inc.



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January 14, 2013

### **By Regular and Electronic Mail**

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Delta Stewardship Council  
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[RulemakingProcessComment@deltacouncil.ca.gov](mailto:RulemakingProcessComment@deltacouncil.ca.gov)

RE: Delta Stewardship Council Proposed Rulemaking

Dear Chairman Isenberg and Council Members:

The State Water Contractors, Inc. and San Luis & Delta-Mendota Water Authority, collectively referred to herein as the "Public Water Agencies",<sup>1</sup> submit this letter pursuant to the Notice of Proposed Rulemaking the Delta Stewardship Council ("Council") submitted to the Office of Administrative Law ("OAL") on November 16, 2012. The Public Water Agencies value the role the Legislature established for the Council. However, the regulations the Council submitted to OAL on November 16, 2012 and propose for adoption ("Proposed Regulations") go well beyond statutory authorities granted to the Council through the Sacramento-San Joaquin Delta Reform Act of 2009 (Wat. Code, § 85000 et seq., "Delta Reform Act" or "Act"). For that reason, as well as the Proposed Regulations failing to meet other important OAL requirements, the Proposed Regulations, if adopted, would be unlawful. The Public Water Agencies respectfully request that the Council revise the Proposed Regulations, consistent with these comments, before the Council considers their adoption.

### **I. INTRODUCTION**

As detailed below, the Proposed Regulations include a number of provisions that fail to meet the standards of necessity, authority, clarity, consistency, reference, and non-duplication set forth in the Government Code. The Public Water Agencies and their member agencies object to the Proposed Regulations particularly because in numerous respects they exceed and conflict with the limited authority the Legislature conferred upon the Council through the Delta Reform Act.

In the Initial Statement of Reasons, the Council asserts that "implementation of the proposed regulatory policies is necessary in order to *achieve* the coequal goals as enumerated in the 2009 Delta

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<sup>1</sup> Descriptions of the Public Water Agencies are included in Attachment 1 hereto.

Reform Act.”<sup>2</sup> The Council further states that “[t]he authority vested in the Council to make consistency determinations ensures that Delta-related activities will be coordinated and legally enforceable under the oversight of the Council.” (Initial Statement of Reasons at p. 14.) Thus, the Council conceives of its role as that of a “super-regulatory” agency with approval authority over all “Delta-related actions.”<sup>3</sup> In a similar vein, the Council states that “Section 5005 is aimed at achieving [the] policy of reduced reliance on the Delta and improving regional self-reliance *by requiring a significant reduction in the amount of water used, or in the percentage of the water used, from the Delta watershed.*” (Initial Statement of Reasons at p. 4, emphasis added.) It is striking that the Council asserts this outcome as an apparent central responsibility of the Council to achieve, through its appellate review of Delta Plan consistency certifications, notwithstanding the clear absence of such authority in the Delta Reform Act.

Nowhere does the Delta Reform Act authorize or require the Council to act as a “super-agency” with the authority or mandate to “achieve” the coequal goals through its appellate review of covered actions for consistency with the Delta Plan, or to impose reductions in water use from the Delta or the Delta watershed. Such action by the Council would exceed the authority conferred upon it in the Delta Reform Act. The Act simply requires the Council to “develop, adopt, and commence implementation of the Delta Plan pursuant to this part that *further*s the coequal goals.” (Wat. Code, § 85300(a), emphasis added.) Specifically, the Act states that “the Delta Plan shall include subgoals and strategies to *assist in guiding* state and local agency actions related to the Delta”; the Delta Plan “may also identify specific actions that state or local agencies *may* take to implement the subgoals” (*ibid.*, emphasis added); and “[t]he Delta Plan shall *promote* statewide water conservation, water use efficiency, and sustainable use of water” (*id.*, § 85303, emphasis added).

As evidenced by the Legislature’s specific word choices, there was no intent to provide or even imply a regulatory role for the Council with regard to broad water management activities. Indeed, to the contrary, the Council and the Delta Plan are directed to provide guidance and advisory recommendations to further the achievement of various pertinent state policies, with the *limited* exception of establishing an administrative scheme for reviewing appeals of consistency certifications only applicable to statutorily defined “covered actions” undertaken *in* the Delta and Suisun Marsh.

Notably, the state policy in the Delta Reform Act pertaining to reduced reliance on the Delta to meet *future* water supply needs through a statewide strategy is not included in the statutory objectives the Legislature determined are inherent in the coequal goals (*id.*, § 85020), and it is conspicuously absent from the specifically described elements of the Delta Plan (*id.*, § 85300 et. seq.). Thus, nothing in the Delta Reform Act empowers the Council to force “significant reductions” in water use from the Delta watershed, or a significant reduction in water exports to meet current or historic water supply needs.

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<sup>2</sup> State of California, Delta Stewardship Council, California Code of Regulations, Title 23. Water, Division 6. Delta Stewardship Council, Chapter 2. Consistency with Regulatory Policies Contained in the Delta Plan, Initial Statement of Reasons 14 (“Initial Statement of Reasons”), <http://deltacouncil.ca.gov/sites/default/files/documents/files/3%20-%20InitialStatementReasonDraftNov2012.pdf>.

<sup>3</sup> “Delta-related actions” is not a term defined in the Act or in the Proposed Regulations. By statute, the Council has no authority to adjudicate appeals over consistency certifications for all “Delta-related actions,” but only for statutorily defined “covered actions.”

Moreover, the Delta Reform Act expressly recognizes the continuing authority of other state and federal regulatory regimes over the management and regulation of water and other resources in the Delta. (See, e.g., Wat. Code, §§ 85031(d), 85032.) This was made clear in the final analysis of SBX7-1 considered by the Senate before voting on the Act. The analysis concludes that the various savings clauses in the bill “maintain SWRCB jurisdiction and preserve regulatory authority generally, in order to clarify that the new Delta Stewardship Council is NOT a super-regulatory agency that trumps other regulatory agencies such as SWRCB and DFG.”<sup>4</sup> Thus, the substantive mandates that the Council seeks to promulgate and enforce are inconsistent with the Delta Reform Act and other statutes.

In addition, the coequal goals are set forth in the statute as state *policy*. As demonstrated below, these policies are not legislative mandates, and they are clearly not mandates that the Legislature authorized the Council to enforce. Instead, the Delta Plan is expressly defined in a way that acknowledges it is but one tool that will provide policy makers with an important source of guidance for, and a means of tracking progress toward, achieving the coequal goals established by the Legislature. Rather than creating an agency charged with regulating the State’s water resources, the Legislature established a framework for a collaborative and synergistic approach to improving overall Delta management and contributing to the achievement of the coequal goals by the pertinent local, state and federal agencies already responsible for carrying out or regulating various components of the Delta Plan.

Because the Council is not authorized to impose substantive mandates regarding water use through the Delta Plan, the Public Water Agencies respectfully request that the Council revise its proposed regulations to remove any such mandates.

## **II. LEGAL STANDARD FOR REGULATIONS**

At the most fundamental level, the Proposed Regulations must be within the scope of the Council’s statutory authority and consistent with controlling law. (Gov’t Code, § 11342.1 [“Each regulation adopted, to be effective, shall be within the scope of authority conferred and in accordance with standards prescribed by other provisions of law”].) An administrative agency such as the Council has no inherent power; it possesses only those powers granted to it by the Constitution or by statute. (*Security National Guaranty, Inc. v. California Coastal Commission* (2008) 159 Cal.App.4th 402, 419.) “That an agency has been granted some authority to act within a given area does not mean that it enjoys plenary authority to act in that area.” (*Ibid.*) Thus, any act taken in excess of the power conferred upon an agency is void. (*Ibid.*)

Similarly, no regulation adopted by a state agency is “valid or effective unless consistent and not in conflict with the statute and reasonably necessary to effectuate the purpose of the statute.” (Gov’t Code § 11342.2; see *Sabatasso v. Superior Court* (2008) 167 Cal.App.4th 791, 796 [“agencies do not have discretion to promulgate regulations that are inconsistent with the governing statute or amend the statute or enlarge its scope,” citation omitted]; *Rich Vision Centers, Inc. v. Board of Medical Examiners* (1983) 144 Cal. App. 3d 110, 114 [an agency “may exercise such additional powers as are necessary for

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<sup>4</sup> Bill Analysis for SBX7-1 as amended November 3, 2009, p. 15, available at [http://www.leginfo.ca.gov/pub/09-10/bill/sen/sb\\_0001-0050/sbx7\\_1\\_cfa\\_20091104\\_035148\\_asm\\_floor.html](http://www.leginfo.ca.gov/pub/09-10/bill/sen/sb_0001-0050/sbx7_1_cfa_20091104_035148_asm_floor.html).

the due and efficient administration of powers expressly granted by statute, or as may be fairly be implied from the statute granting the powers”].)

Government Code section 11349 *et seq.* governs the OAL review of regulations. OAL must make determinations of the necessity, authority, clarity, and consistency of proposed regulations in addition to ensuring compliance with the other procedural and substantive mandates of the Administrative Procedure Act (“APA”). As explained below, a number of provisions in the Proposed Regulations fail to meet the OAL’s standards and must be removed or revised accordingly.

### **III. DEFICIENCIES WITH PROPOSED REGULATIONS**

#### **A. The Proposed Regulations Exceed The Council’s Authority Granted To It Through The Water Code**

To be valid and effective, the Council must demonstrate that the Proposed Regulations are authorized by the Delta Reform Act, and do not conflict with controlling law. "Authority," as defined by Government Code section 11349(b), means "the provision of law which permits or obligates the agency to adopt, amend, or repeal a regulation." Proposed regulations are also invalid if they impair or conflict with the statute they purport to implement. (*California Association of Psychology Providers v. Rank* (1990) 51 Cal.3d 1, 11; *Esberg v. Union Oil Co.* (2002) 28 Cal.4th 262, 269.) The Proposed Regulations fail these standards as they exceed and transgress the Council’s statutory authority and conflict with controlling law.

#### **1. The Substantive Mandates in Proposed Sections 5004 and 5005 Exceed the Council’s Statutory Authority and Conflict with Controlling Law; Therefore, They Must Be Removed from the Proposed Regulations**

**Section 5004:** The requirements imposed through this section of the Proposed Regulations are intended to govern certifications of consistency filed by state or local public agencies with regard to covered actions. The proposed requirements, however, are not fully set forth in the Proposed Regulations. On page 59 of the current draft of the Delta Plan, it states: “If the covered action is found to be inconsistent, *the project may not proceed until it is revised so that it is consistent with the Delta Plan.*” (Emphasis added.) In other words, the Council claims the authority to preempt already established statutory processes and to itself *prohibit* the action from moving forward until it has determined the project is consistent with the Delta Plan. That claim of what is essentially permitting authority is inconsistent with the language of the Delta Reform Act, as well as its legislative history. It also is unenforceable because it is an unlawful “underground regulation” that has not been submitted to OAL.

**The Plain Language of the Delta Reform Act Does Not Authorize the Council to Prohibit a Covered Action Until It Determines It Is Consistent with the Delta Plan:** Under the Delta Reform Act the proponent of a proposed action potentially affecting the Delta must determine if it is a “covered action.” If the agency determines it is a covered action, it must certify to the Council that it is consistent with the Delta Plan. (Wat. Code, § 85225.) Absent an appeal, the agency may continue to pursue regulatory

approvals and implement the action. If the certification is appealed, the Council must determine whether the certification is supported by substantial evidence. If the Council determines the certification is not so supported, it remands it to the agency. (Wat. Code, §§ 85225.10-85225.25.)

On remand the “agency may determine whether to proceed with the covered action.” (Wat. Code, § 85225.25.) Its options are to (i) “proceed with the action” as proposed or (ii) proceed with “the action as modified to respond to the findings of the council.” (*Ibid.*) In either case it must, “prior to proceeding with the action file a revised certification of consistency that addresses each of the findings by the council.” (*Ibid.*) That is the end of the certification process. Nothing in this language prohibits the agency from proceeding with the covered action even if the Council has deemed it inconsistent, so long as the agency files a revised certification addressing the Council’s findings. The Council’s assertion that a covered action is prohibited unless the Council deems it consistent simply is not supported by the plain language in the Delta Reform Act.

The Delta Reform Act’s Legislative History also Undermines the Council’s Assertion of Authority to Prohibit Implementation of a Covered Action Until an Appeal Is Resolved to the Council’s Satisfaction. The October 2008 Delta Vision Strategic Plan, an early step in developing the governance structure that resulted in the Delta Reform Act, would have created a Council as a “regulatory and oversight body” with numerous and broad regulatory authorities. (Delta Vision Strategic Plan, pp. 121-24.) These would have included the power to determine the consistency of covered actions and to “ensure federal and state consistency with the [Plan].” (Delta Vision Strategic Plan, pp. 123-24.) The Delta Reform Act significantly pared these proposals down. In particular, the authority to determine consistency in the first instance and the authority to “ensure” consistency overall before a project may be implemented are both absent from the Delta Reform Act.

The legislative history of the Delta Reform Act demonstrates that the Legislature purposefully removed provisions that would have authorized the Council to prevent an inconsistent “covered action” from being implemented. Proposed Conference Report No. 1, dated September 9, 2009, contains an appeals process similar to that in the enacted Delta Reform Act. Like the enacted version, it provided that a covered action may be implemented if no appeal is filed to the consistency certification. However, the *pre-print* version of section 85225.25 provided:

Upon remand, the state or local agency may determine not to proceed with the covered action or may modify the appealed action and resubmit the certification of consistency to the council. A proposed covered action appealed pursuant to these provisions shall not be implemented until the council has adopted written findings, based on substantial evidence in the record, that the covered action, as modified, is consistent with the Delta Plan.

Delta Reform Act section 85225.25 *as enacted* is significantly changed from this earlier version. While the prior version gives the agency the option of either not proceeding with the action or modifying the action to satisfy the Council, the enacted version gives the agency the option to “proceed with the action” *without* modification, or as modified, provided it files a revised certification. Finally, the

Legislature pointedly removed the prohibition that the proposed action “shall not be implemented” without a Council consistency determination. Despite the Legislature’s purposeful refusal to adopt a statute mandating that a covered action shall not be implemented absent a Council blessing, the Council is attempting to reinsert that rejected mandate. This attempt clearly is an illegal alteration, amendment and enlargement of the statute that is beyond the Council’s authority. (Gov’t Code, §§ 11342.2 & 11349.1; see also OAL Handbook, p. 19.)

These changes to subsequent versions of the Act and the language of the Delta Reform Act expressly permit implementation of a covered action when the Council disagrees with an implementing agency’s consistency certification. Upon remand from an appeal, an agency is not required to modify a proposed covered action, but only to file a revised certification addressing the Council’s findings. The plain language of the Act and its legislative history manifest the Legislature’s intent to preserve the authority of state and local agencies to proceed with “covered actions” even if the Council ultimately disagrees with a proffered consistency certification.

Attempts to Implement Underground Regulation Are Unlawful: The APA specifically prohibits an agency from making use of a rule which meets the definition of a “regulation” but has not been submitted to the OAL for approval, referred to as an “underground regulation.” (Gov’t Code, § 11340.5(a); OAL Handbook, pp. 12-16.) “Underground regulations” are a means to avoid the requirements of the APA and can take the form of “‘policies,’ ‘interpretations,’ ‘instructions,’ ‘guides,’ ‘standards,’ or the like, and are contained in internal organs of the agency.” (OAL Handbook, pp. 13-14, citing *Armistead v. State Personnel Board* (1978) 22 Cal.3d 198.)

Here, the Council claims the authority to prohibit an agency from proceeding with a project unless the Council has deemed it consistent with the Delta Plan: “If the covered action is found to be inconsistent, the project may not proceed until it is revised so that it is consistent with the Delta Plan.” (Draft Delta Plan at p. 59.) As explained above, this proposed rule is not within the Council’s authority. Nevertheless, the Council has included it in the Delta Plan.<sup>5</sup>

Although the Council has not designated it as a Regulatory Policy, it clearly would meet the definition of “regulation” under Government Code Section 11342.600, that is, a “rule, regulation, order or standard” contained in a Delta Plan adopted by the Council purportedly “to implement, interpret, or make specific the law . . . administered by it.” The proposed mandate meets the three part test specified in the OAL Handbook at p. 14: (1) it is a rule of standard or general application with respect to the consistency process; (2) it is a policy adopted by the Council to implement or make specific the law administered by it; and (3) it is not exempt under the APA.

The Council’s assertion of the authority to prohibit implementation of an action it deems inconsistent with the Delta Plan is not supported by the language or legislative history of the Delta

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<sup>5</sup> The Council is authorized to adopt “administrative procedures governing appeals” that are not required to be submitted to OAL. (Wat. Code, § 85225.30.) However, the provision at issue is not procedural. It is instead a substantive rule of law affecting the State’s or a public agency’s ability to carry out its statutory responsibilities, and it impairs the property rights of an entity applying for the permit or other approval at issue.

Reform Act and is an unlawful “underground regulation.” The Council’s assertion of authority is unenforceable and should be deleted from the Delta Plan.

**Section 5004(b)(3)**: The Proposed Regulations state that “[a]s relevant to the purpose and nature of the project, *all covered actions must document use of best available science* (as described in Appendix 1A).” (Emphasis added.) The Council asserts that this regulatory requirement is necessary for consistency with the Delta Plan “to ensure that all significant actions [affecting the Delta] utilize best available science or adaptive management in particular.” (Initial Statement of Reasons at p. 2.)

The use of best available science in evaluating the merits of a covered action should be encouraged. However, this proposed regulation exceeds the Council’s authority to the extent that it imposes higher standards for state and local agency actions than can be found in the Delta Plan or elsewhere in controlling law. (See, e.g., Code Civ. Proc., § 1094.5(c) [substantial evidence in light of the whole administrative record]; Pub. Resources Code, § 21168.5 [abuse of discretion established for purposes of CEQA if a determination or decision is not supported by substantial evidence]; Cal. Code Regs., tit. 14, § 15384 [defining substantial evidence].) The Council lacks authority to limit or alter the scope of local agency discretion by requiring that all covered actions that have a significant impact on the achievement of the coequal goals must use (and document the use of) best available science and adaptive management, *even where no other applicable law imposes such a requirement*.

The Council’s stated basis for this requirement is that “despite the Delta’s special status, there are no overarching guidelines or best management practices to ensure that all significant actions utilize best available science or adaptive management in particular.” (Initial Statement of Reasons at p. 2.) However, the Delta Reform Act does not require proponents of covered actions to support their decisions with the best available science or utilize adaptive management in all situations. The *Council’s* adoption of the Delta Plan must be supported by the best available science. (Wat. Code, §§ 85302(g), 85308(a).) But nothing in the Act authorizes the Council to impose that evidentiary standard on covered actions. In addition, the Delta Plan itself can be based upon the best available science without requiring every covered action to also be based on the best available science. Thus, the proposed requirement is not reasonably necessary for the Council to fulfill its obligation to use the best available science.

In addition, such a requirement would result in a new standard for implementing agency decision making. This new standard could, in turn, expose implementing agencies and the Council to potential litigation over the intensively fact-specific determination whether an implementing agency has used the best available science, whether it has adequately documented such use, and whether the Council’s determination to that effect in a certification appeal is supported by substantial evidence in the administrative record.

To the extent that such a requirement is already imposed by other statutes or regulations, the regulation is duplicative, and would add nothing but another layer of paperwork to an implementing agency’s regulatory burden. Thus, the proposed requirement is not only unauthorized, unnecessary, and administratively burdensome, it could lead to unintended consequences for implementing agencies as well as the Council.

The requirement that all covered actions that significantly impact the achievement of the coequal goals must use and document the use of the best available science should be removed from the Proposed Regulations.

**Section 5004(b)(5)**: This subsection requires a certifying agency that will carry out a covered action to also certify that “the covered action complies with all applicable laws pertaining to water resources, biological resources, flood risk, and land use and planning[,]” and if the certifying agency will approve or fund, but not carry out, the covered action, then it must “include a certification . . . that the covered action complies with all applicable laws of the type listed above over which that agency has enforcement authority or with which that agency can require compliance.” These additional certifications are not authorized in the Delta Reform Act, and they are unnecessary and duplicative of existing laws. If these additional certifications are required by regulation, then, in addition to any potential liability for an alleged failure to comply with the *substantive* mandates of those other applicable laws, project opponents could also bring an appeal before the Council, and potentially file litigation in state court challenging the *certification* of compliance with other substantive laws, *and* the Council’s determination of consistency on any appeal, in addition to litigation in state or federal court challenging the alleged failure to comply with the *substantive* mandates of the law.

Consequently, this requirement should be removed because it would increase regulatory burdens on agencies, including the Council, and it would increase the potential for litigation and the attendant costs and delays without providing any benefits in terms of compliance with the law, consistency with the Delta Plan, or furthering achievement of the coequal goals.

**Section 5005**: The proposed “regulatory policy” WR P1 unlawfully asserts regulatory power to undertake the enforcement of a new policy of the State to “reduce reliance on the Delta in meeting California’s future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency.” (Wat. Code, § 85021.) In the Notice of Proposed Rulemaking, the Council claims that requiring reduced reliance on the Delta is “consistent with the Delta Reform Act contained in Water Code §85021 (Notice of Proposed Rulemaking at 3), but this assertion of authority reaches far beyond the substantive and geographic scope of its authorities as explicitly delineated by the Legislature. Furthermore, because the Delta Reform Act does not expressly give the Council a duty or the power to enforce or regulate the general state policy of seeking to “reduce reliance on the Delta in meeting future water supply needs,” there is no implied authority to promulgate regulations pertaining to that policy. The only specific language articulated in the Act arguably related to such potential authority merely directs the Council to “promote” conservation and other water management activities that would contribute to furthering the state policy expressed in Section 85021 and elsewhere in the Act and other bills that were part of the comprehensive water package of which the Act was only a part.

**The Language of the Statute Does Not Support the Council’s Asserted Authority to Require a Significant Reduction in Water Use.** Nowhere in the Act’s sections providing explicit direction to the Council regarding content of the Delta Plan (see Wat. Code, §§ 85300-85308) is the reduced reliance policy mentioned or cited as a focus of the Delta Plan. The reduced reliance policy in Section 85021 of

the Act is simply a statement of policy, not a delegation to the Council of power to expand or enforce the policy. The Council is not even mentioned in section 85021, let alone authorized to enforce the policy through forced reductions in current or historic supplies pumped from the southern Delta. It is telling that while the Act did not include any standards or criteria in the Section 85021 policy statement, other bills included as part of the comprehensive water package did specifically target establishing statewide standards and criteria related to increasing water conservation throughout California.<sup>6</sup>

In fact, Section 85021 does not require a “reduction” in current supplies from the Delta at all, let alone a “significant reduction.” Instead, it states a policy to take positive actions to increase local supplies and water efficiency through investment as a means to reduce reliance on the Delta “in meeting California’s future water supply needs.” The Council’s proposed Section 5005 attempts to turn that positive, statewide investment policy into a prescriptive rule prohibiting entities that need to export, transfer through, or use water in the Delta or in the entire Delta watershed from doing so unless they have demonstrated “a significant reduction in the amount of water used, or in the percentage of water used, from the Delta watershed.” The Council’s attempt to add this requirement where the Legislature did not would “alter or amend [the] statute or enlarge or impair its scope” and therefore “is void and must be struck down by a court.” (OAL Handbook at p. 19.)

Moreover, the Council ignores the Legislature’s focus on reducing reliance in meeting California’s *future* water supply needs and instead attempts to require a reduction from current use. But on its face, section 85021, through the express use of the term “future,” applies solely to water supply needs that do not currently exist as opposed to current water supply needs. In *Tenet/Centinel Hospital Medical Center v. Workers’ Compensation Appeals Board* (2000), the court, in interpreting a statute, was required to distinguish between “continuing” or “further” medical treatment and “future” treatment. (80 Cal.App.4th 1041, 1046.) Looking to the Webster Dictionary, a common reference for statutory interpretation, the Court concluded that whereas “continuing” means “constant” and “further” means “going or extending beyond what exists”, the term “future” means “existing or occurring at a later time.” (*Id.*) The court went on to find that “future” medical care suggested medical attention that would be required at a later date but is not ongoing. (*Id.*) Using this definition of the term “future,” Section 85021 applies to water supply needs that do not currently exist but would arise in the future due to population and economic growth absent the statewide investment strategy called for in Water Code section 85021.

The principles of statutory interpretation require that each word in a statute be given significance. (*Dyna-Med, Inc. v. Fair Employment and Housing Comm’n* (1987) 43 Cal.3d 1379, 1386-87.) The Council’s interpretation that Section 85021 calls for a reduction in the use of Delta water from current water supply levels renders the term “future” as surplusage. Under that interpretation, Section

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<sup>6</sup> See generally 2009 Water Bills SBx7-7 and SBx7-8, which specifically discuss and seek to reduce per capita use of water in the context of statewide strategies related to conservation, diversification of water supply portfolios, and funding to further achieve those policy goals.

85021 would have stated a policy to reduce reliance on the Delta in meeting California's water supply needs, generally, which the Legislature explicitly chose not to do<sup>7</sup>.

Moreover, two other significant sections of the Delta Reform Act are inconsistent with the Council's position. In Section 85020, the section immediately preceding Section 85021, the Legislature spelled out in specific detail the objectives "inherent in the coequal goals for management of the Delta." Rather than requiring, as the Council would, the "significant reduction" in use of water from the Delta watershed, the Legislature stated the objective is to "promote" statewide water conservation, water use efficiency and sustainable water use. This Legislative objective demonstrates that the Legislature did not choose to confer regulatory authority on the Council but instead provided discretion to "promote" activities related to "sustainable water use." The Legislature's use of "promote" cannot legitimately be interpreted to mean "mandate."

Part 4, Chapter 1 of the Delta Reform Act (Wat. Code, §§ 85300-85309) also demonstrates that Section 85021, while a general policy statement that is certainly relevant when considering actions affecting the Delta, does not delegate any enforcement authority to the Council or even to any of the agencies that do have regulatory authority in the Delta. In particular, while the Legislature devoted these several sections to specifying in detail the elements to be required in the Delta Plan, it did not include or refer to the general Section 85021 policy. What it did do was require that the Delta Plan "shall promote statewide water conservation, water use efficiency, and sustainable use of water." (Wat. Code, § 85303.) This is yet another demonstration that the Legislature did not empower the Council to regulate water use but instead directed it to "promote" good water management in line with section 85021. (See also Wat. Code, § 85302(d)(1), (2) [directing the inclusion of measures to "promote" a more reliable water supply that "[m]eet[s] the needs for reasonable and beneficial uses of water" and "[s]ustain[s] the economic vitality of the state"].)

In addition, the Delta Reform Act limits the Council's consistency review authority to "covered actions," which are limited to projects that "[w]ill occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh." (Wat. Code, § 85057.5.) Thus, the Council's assertion of authority to mandate reductions in the use of water anywhere in the State is clearly beyond the geographic scope of the Council's authority.

Moreover, the Council's assertion of authority over water use is inconsistent with several savings clauses in the Delta Reform Act. The statute provides that:

Unless otherwise expressly provided, nothing in this division supersedes, reduces, or otherwise affects existing legal protections, both procedural and substantive, relating to the [State Water Resources Control Board's] regulation of diversion and use of water, including, but not limited to, water rights priorities, the protection provided to

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<sup>7</sup> This is clearly revealed by the legislative history described below, which also illuminates the significance of the Legislature's use of the phrase "reduce reliance" on the Delta, in contrast to "reduce dependence." The legislative history confirms that the Legislature did not intend the Delta Plan to be an *enforcement* mechanism for the newly established policy of reducing reliance on the Delta to meet future water supply needs, or for the Council to be its enforcer.

municipal interests by Sections 106 and 106.5, and changes in water rights. Nothing in this division expands or otherwise alters the board's existing authority to regulate the diversion and use of water or the court's existing concurrent jurisdiction over California water rights.

(Wat. Code, § 85031(d).)

The Council's assertion of authority to mandate reductions in water diversions and water use throughout the State is inconsistent with these important savings provisions in the statute, and would intrude upon the exclusive concurrent jurisdiction of the State Water Resources Control Board and the courts to adjudicate and regulate water diversions and water rights.

The courts have held that general statements of legislative intent do not create an affirmative duty or authority on the part of the agency to impose a mandate in furtherance of the policy. (E.g., *City of Arcadia v. State Water Resources Control Bd.* (2011) 191 Cal.App.4<sup>th</sup> 156, 175-176; *Shamsian v. Dept. of Conservation* (2006) 136 Cal.App.4<sup>th</sup> 621, 633.) Therefore, the Council's assertion of authority to regulate water use is inconsistent with the express statutory language and an enlargement of the Council's authorities beyond those provided in the Delta Reform Act.

Ultimately, while it is consistent with the statutory scheme for the Council to "promote" activities that could contribute to reducing reliance on the Delta in meeting future water supply needs, the proposed section 5005 mandate is not "reasonably necessary to effectuate the purpose" of the Delta Reform Act, and it is therefore beyond the Council's authority and should be removed from the Proposed Regulations. (Gov't Code §§ 11342.2, 11349(a)(1) & (2).)

Thus, this provision should be removed from the Proposed Regulations.

**Section 5005(c):** The prohibition of exports from the Delta proposed in subsection (c) is also not authorized by the Delta Reform Act for the reasons explained above; and it is also inconsistent with the Delta Reform Act's exclusion of routine project operations from the definition of covered actions and with its several savings clauses.

The Delta Reform Act specifically excludes from the definition of "covered action" "[r]outine maintenance and operation of the State Water Project or the federal Central Valley Project." (Wat. Code, § 85057.5(b)(2).) In addition, as demonstrated, the Delta Reform Act provides that "[n]othing in the application of this section shall be interpreted to authorize the abrogation of any vested right whether created by statute or common law" (*id.*, § 85057.5(c)), and "[n]othing in this division expands or otherwise alters the [State Water Resources Control Board's] existing authority to regulate the diversion and use of water or the courts' existing concurrent jurisdiction over California water rights" (*id.*, § 85031(d)).

Thus, the Council lacks the authority to require a reduction in exports of water via the routine operation of the State Water Project ("SWP") or the federal Central Valley Project ("CVP"), and this provision should be removed from the Proposed Regulations.

The Legislative History Directly Contradicts the Council’s Assertion of Regulatory Authority to Prohibit or Mandate the Actions Required in Section 5005: While it is clear from the face of the statute that the Council does not have the authority to promulgate the mandates in Section 5005, the legislative history provides additional evidence of the Legislature’s intent that the reduced reliance policy promote general water management activities and programs to meet future water supply needs, rather than delegating authority to the Council to mandate a requirement that water use be “significantly reduced.”

Statements by legislators who were key in the sponsorship, drafting and adoption of the Act explicitly sought to clarify the reach of Section 85021 as it was being considered. They agreed it was a “broad statement of a policy goal . . . certainly not a mandate.” And they agreed that *reducing dependence* on the Delta to meet California’s water supply needs *was not* an appropriate policy objective. These conclusions were articulated at a September 3, 2009, joint Senate and Assembly conference committee hearing discussing the various bills that would result in the Delta Reform Act, including SBx7-1, which established the Council and outlined in detail the contents and purposes of the Delta Plan:

**Senator Aanestad:** “To say that we are going to be able to decrease dependency on the Delta is an impossible goal . . . . The solution is the second part of this paragraph [revised 85021 referring to statewide strategy of investment] and that is to improve efficiency, conservation, etc. . . . , it’s foolishness to say we are going to become less dependent on the Delta. I think it’s imperative to say we’re going to be more responsible with the water that goes through the Delta . . . .”

Colloquy between Senator Steinberg (Senate Majority Leader and coauthor of SBx7-1) and Assemblyman Huffman (Chairman of the Assembly Water, Parks and Wildlife Committee and author of Preprint Assembly Bill No. 1, the Assembly’s version of SBx7-1):

**Senator Steinberg:** “[O]ne question for consideration is whether or not the proponents of this language [section 85021] intended it to have legal import or is it a statement of intent.”

**Assemblyman Huffman:** “I think, Mr. Chair, ***we know how to write mandates when we want to, that’s not how this reads, it reads as a broad statement of policy of a goal that will guide things going forward*** . . . . You reduce dependence by following some of the ***conservation measures that we are asking folks to do in separate legislation*** . . . . So, I think it reflects a prudent policy guidance for the state going forward but ***certainly not a mandate.***” [Emphasis added.]

**Senator Cogdill** (Lead sponsor of the companion Water Bond): “[I]t ought to be more about how we make the Delta a more reliable source of water rather than to say we are going to do everything we can to limit exports from that very important source.”

The Legislators’ agreement reflected in these exchanges is supported by the Legislative drafting history of section 85021 and related sections. As originally drafted Water Code Section 85021 read:

The policy of the State of California is to ***reduce dependence on water from the Delta watershed, over the long-term***, for statewide water supply reliability. Each region that depends on water from the Delta shall improve its regional self-reliance for water through investment in water-use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts. (Preprint SB 1 (Aug. 4, 2009).) [Emphasis added.]

That language was amended on September 9, 2009,<sup>8</sup> after the September 3 discussions quoted above, to the language adopted ultimately and now codified in section 85021:

The policy of the State of California is to **reduce reliance on the Delta** in meeting California's **future water supply needs** through a **statewide strategy** of investing in improved regional supplies, conservation, and water-use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water-use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts. [Emphasis added.]

The significant changes to the first sentence of the section are italicized and bolded to emphasize the differences between the earlier draft version, and the ultimately adopted version of section 85021. The first revision changes “reduce dependence” on water from the Delta watershed “over the long-term” to “reduce reliance” on the Delta “in meeting California’s future water needs.” Similar to the discussion above of *Tenet/Centinela Hospital Medical Center v. Workers’ Compensation Appeals Board*, the adopted term “future” (as opposed to “continuing” or “existing”) means “existing or occurring at a later time.” In other words, the Section 85021 policy envisions reduced reliance on use of Delta water over use that would exist or occur *in the future* if the policy were not implemented. It does not mean reduce “continuing” or “existing” reliance on Delta water “beyond what exists” currently or historically.

The second significant change is the addition of the language regarding a “statewide strategy of investment.” This is an important reflection of legislative intent that meeting the policy directive set forth in Section 85021 is to be achieved on a “statewide” basis that would include local initiatives and investments, statewide bond initiatives, or other funding mechanisms. Notably, nowhere does this language expressly or impliedly authorize the Council to impose an obligation to “significantly reduce” the current use of water from the Delta watershed, or an authorization to the Council to “enforce” its particular interpretation of Section 85021 through the Delta Plan.

The Proposed “Significant Reduction” Requirement Is Inconsistent with the Legislature’s Deletion from the Bill of a Similar Requirement: Another indication the Legislature did not intend to require (or authorize the Council to regulate) a reduction of current use of water is its consideration and rejection of a proposed section 85219. That section would have prohibited construction of a

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<sup>8</sup> Conference Rept. No. 1, SB 12 (Sept. 9, 2009).

conveyance facility within or around the Delta until the Council made a determination that agencies relying on the facility for water deliveries had submitted “long-term plan[s] for reducing reliance on those exports.” (Preprint SB 1 (Aug. 4, 2009).) That language, which could have been interpreted to support the “significant reduction” requirement the Council is attempting to impose, was deleted at the same time Section 85021 was amended to add “future water supply needs” and the “statewide strategy of investment” language.

The substantive mandate in proposed Section 5005 is inconsistent with both the plain language of the Delta Reform Act and its legislative history, and should be removed from the Proposed Regulations.

**Section 5005(e)(1)**: The language of the statute does not support the Council’s asserted authority to require (e)(1)(A), (B), and (C), as a prerequisite for using, exporting, or transferring water through the Delta. For example, subdivision (A) mandates that every water supplier that might receive water from the “covered action” has an urban and agricultural management plan. This is a current requirement under law for certain water suppliers, and is therefore duplicative and unnecessary. (Wat. Code, § 10620 [urban water suppliers]; *id.*, §10820 [agricultural water suppliers].)

Of more concern, as currently proposed Subsections 5005(c) – (e) appear to create a new consequence for water supplies that fail to meet novel requirements that the Council has proposed for inclusion in urban and agricultural water management plans in subsections (e)(1)(B) and (C); namely, a potential denial of the ability to use or export water from, or transfer water through, the Delta. Current law, however, has very limited specific repercussions for a failure to adopt these plans in compliance with the specific requirements set forth in the Water Code. (Wat. Code, §§10608.56(a), (c), (e), (f); 10631.5 [terms of and eligibility for certain water management grants or loans for urban water suppliers]; *id.*, §§ 10608.56(b), (e), (f); 10852 [agricultural water suppliers].) Nothing in the Delta Reform Act provides authority for the novel requirements for urban and agricultural water management plans proposed in subsections (e)(1)(B) and (C) of Section 5005. In addition, insofar as these subsections duplicate existing law, they are unnecessary and create confusion in the regulated community.

Furthermore, Section 5005(e)(1)(B) distorts the purpose of urban and agricultural water management plans. These plans are internal long-range documents that are to be revised over time as conditions and technologies change. Therefore, the implementation schedules set forth in the plans must remain flexible and adaptable. These plans are meant to inform local water management planning, not to create a new forum for regulation by the Council. Similarly, in subsection 5005(e)(1)(C) the Council grants itself the authority to require a new provision in all water management plans starting in 2015. The Delta Reform Act does not give the Council this authority, and there is no such requirement in existing law. (See Wat. Code, § 10631 [elements of an urban water management plan]; *id.*, § 10826 [agricultural water management plan]; *id.*, § 10608 et seq. [requirements for urban and agricultural water management plans related to sustainable water use and demand reduction].)

Thus, Subsections 5005(c) – (e) should be removed from the Proposed Regulations.

**2. The Definition of “Achieving the Coequal Goal of Providing a More Reliable Water Supply for California” Includes Unlawful Substantive Mandates to Reduce Water Use**

**Section 5001(e)(1):** The Council proposes to include a definition of “achieving the coequal goal of providing a more reliable water supply for California” to include “[b]etter matching the state’s demands for reasonable and beneficial uses of water to the available water supply” (§ 5001(e)(1)(A)), and states that “[r]egions that use water from the Delta watershed *will* reduce their reliance on this water for reasonable and beneficial uses, and improve regional self-reliance” (§ 5001(e)(1)(B), emphasis added), and “[w]ater exported from the Delta *will* more closely match water supplies available to be exported, based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem” (§ 5001(e)(1)(C), emphasis added). In addition, the proposed definition states: “Delta water that is stored in wet years will be available for water users during dry years, *when the limited amount of available water must remain in the Delta*, making water deliveries more predictable and reliable.” (§ 5001(a)(1)(C), emphasis added.)

The proposed regulatory definition of “achieving the coequal goal of providing a more reliable water supply for California” conflicts with the language and structure of the Delta Reform Act. (Wat. Code, § 85302(d)(1).) Specifically, the statute mandates that “[t]he Delta Plan shall include measures to promote a more reliable water supply that address all of the following,” including “[m]eeting the needs for reasonable and beneficial uses of water.” (*Ibid.*) Furthermore, the Delta Reform Act’s coequal goal for water supply is to provide “a more reliable water supply for California . . . .” (Wat. Code, §§ 85054, 85020(a).) The Legislature has declared that seven specific objectives “are inherent in the coequal goals for management of the Delta[,]” including the objectives to “[i]mprove the water conveyance system and expand statewide water storage.” (Wat. Code, § 85020(f).)

First, the proposed definition of achievement of the coequal goal of a more reliable supply of water does not promote or identify actions that will *meet* water needs. Instead, it defines achieving the coequal goal of a more reliable water supply in a manner that *limits* use of water from anywhere in the Delta watershed, and limits water exports from the Delta.

Specifically, the proposed definition purports to impose a substantive requirement on all those who use water that originates anywhere in the Delta watershed to “reduce reliance on this water for reasonable and beneficial uses.” This mandate is an unauthorized expansion beyond the *policy* of the State of California articulated in the Delta Reform Act “to reduce reliance on the Delta in meeting California’s *future* water supply needs through a *statewide strategy* of investing in improved regional supplies, conservation, and water use efficiency.” (Wat. Code, § 85021, emphasis added.)

As demonstrated above, the Legislature did not include the statewide policy of reduced reliance on the Delta to meet *future* water supply needs in the policies “inherent” in the coequal goals, or in its specified elements required to be part of the Delta Plan. (Wat. Code, §§ 85020, 85300 et. seq.) Thus, the Legislature has not authorized the Council to adopt a new mandate applicable to all users of water from the Delta watershed regarding *current or historic* water supply needs based on this general

expression of state policy that depends on a *statewide* strategy to reduce reliance on the Delta to meet *future* water supply needs. (See Wat. Code, §§ 85210 [enumerated powers of the Council notably lacks any authority to convert state policy into new substantive mandates]; 85212 [authorizing Council to “provide timely *advice* to local and regional planning agencies regarding consistency of local and regional planning documents . . . with the Delta Plan,” emphasis added]; 85300(a) [requiring the Council to develop a Delta Plan pursuant to the Delta Reform Act “that *further*s the coequal goals” and includes “subgoals and strategies *to assist in guiding* state and local agency actions related to the Delta,” emphasis added].) The precatory and permissive language in the Delta Reform Act cannot be reasonably interpreted as authorizing the Council to mandate reductions in water use or water exports.

Second, the proposed definition purports to require that those who export water from the Delta, i.e., the Department of Water Resources and U.S. Bureau of Reclamation, reduce exports in “dry years, when the limited amount of available water must remain in the Delta . . . .” This provision in the proposed definition implies that consumptive uses will only get what is available after other “in-stream” uses are met. In addition, the statement is ambiguous, suggesting that in undefined “dry years,” exports may be reduced to zero because “the limited amount of available water must remain in the Delta . . . .”

The failure to recognize or even reference the “public interest” integral to the reasonable and beneficial use of water and the Public Trust doctrine is a fatal deficiency in the Council’s unsubstantiated interpretation of the objective to further the achievement of the coequal goal of a more reliable water supply. Nowhere in the Delta Reform Act did the Legislature authorize the Council to adopt a mandate that state and federal agencies must reduce exports from the Delta. Instead, any limits on exports are governed by other statutory and regulatory requirements administered by other state and federal agencies, including the State Water Resources Control Board, Department of Fish and Wildlife,<sup>9</sup> the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service.

The proposed definition conflicts with the savings clauses in the Delta Reform Act that expressly acknowledge the authority of other state and federal laws and regulations that affect the management of water resources in the Delta and Delta watershed. (See Wat. Code, §§ 85031 [limitations on division], 85032 [subjects not affected by division]; see also Wat. Code, § 85320(e)-(g) [recognizing that the Department of Water Resources, Department of Fish and Wildlife, and other agencies besides the Council are “charged with BDCP implementation,” and that the Council’s authority is limited to making recommendations to the BDCP implementing agencies regarding implementation of the BDCP, which is to be incorporated into the Delta Plan].)

### **3. The Proposed Definition of “Significant Impact” Is Inconsistent with CEQA and Should Be Removed or Substantially Revised**

**Section 5001(s):** The proposed regulatory definition of “significant impact” impermissibly attempts to alter and amend established CEQA principles regarding baseline conditions and assessment of impacts (direct, indirect, and cumulative), and is in direct conflict with controlling law. (Pub. Resources Code, §§ 21065, 21068; Cal. Code Regs., tit. 14, § 15125; *In re Bay-Delta Coordinated*

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<sup>9</sup> Formerly named the Department of Fish and Game.

*Proceedings* (2008) 43 Cal.4th 1143, 1167-1168; *Communities for a Better Environment v. South Coast Air Quality Management District* (2010) 48 Cal.4th 310, 315, 320-322; *Citizens for East Shore Parks v. State Lands Commission* (2011) 202 Cal.App.4th 549, 557-566.) The Council has no authority to alter the fundamental framework of environmental review, which is concerned with whether approval of a proposed action may result in a significant *adverse* physical change in the existing environment. (Pub. Resources Code, §§ 21065, 21068; Cal. Code Regs., tit. 14, §§ 15060 (c)(2), 15061, 15064, 15125, 15358, 15360, 15378(a); 15382.)

Of special concern is the Council's inclusion of an overbroad definition of any proposed project that appears to include any contribution, no matter how insignificant, to any existing cumulatively significant impact on achievement of the coequal goals. It is conceivable that a proposed project may have an insignificant contribution to a cumulatively significant impact that has resulted from over a century of development in the Delta and Delta watershed. At a minimum, the definition of "significant impact" should be revised to expressly exclude such projects from the definition.

**Section 5003(b)(2)(C):** One-year temporary CVP- and SWP-related water transfers occur regularly and are subject to all terms and conditions and other environmental protections imposed on the SWP and CVP. They therefore are "routine operations" of the SWP and CVP and expressly excluded from the definition of "covered action" by Water Code section 85057.5(b)(2). Moreover, one-year transfers approved by State Water Resources Control Board are exempt from the application of CEQA pursuant to Water Code section 1729, and therefore are not a "project" under Public Resources Code section 21065. Although the proposed regulation administratively exempts one-year temporary water transfers, it does so "only through December 31, 2014." This proposed sunseting of the covered action exclusion is inconsistent with the express language in the Delta Reform Act and will hinder achievement of the coequal goal of improving water supply reliability. Accordingly, this Section should be removed from the Proposed Regulations.

**Section 5003(b)(2)(D):** The proposed definition of "covered actions" impermissibly attempts to alter and amend established CEQA principles regarding the definition of a "project," as well as the application of statutory and categorical exemptions, and is in direct conflict with controlling law. (Pub. Resources Code, § 21065; Cal. Code Regs., tit. 14, §§ 15300.2 (c), 15378; 15382.) Statutory exemptions under CEQA are absolute; they reflect legislative policy determinations and are not subject to any exceptions for "unusual circumstances." (Cal. Code Regs., tit. 14, § 15061(b)(2); *Sunset Sky Ranch Pilots Association v. County of Sacramento* (2009) 47 Cal.4th 902, 907; *Great Oaks Water Co. v. Santa Clara Water Dist.* (2009) 170 Cal.App.4th 9576, 966, fn. 8; *Communities for a Better Environment v. California Resources Agency* (2002) 103 Cal.App.4th 98, 128-129.) The Proposed Regulations directly conflict with these established principles. Furthermore, "unusual circumstances" as they pertain to categorical CEQA exemptions have been defined and interpreted under CEQA. (Cal. Code Regs., tit. 14, §§ 15300.2(c); see, e.g., *Banker's Hill v. City of San Diego* (2006) 139 Cal.App.4th 249, 261; *Turlock Irrigation District v. Zanker* (2006) 140 Cal.App.4th 1047; *Santa Monica Chamber of Commerce v. City of Santa Monica* (2002) 101 Cal.App.4th 786, 800; *Fairbank v. City of Mill Valley* (1999) 75 Cal.App.4th 1243, 1260-1261.) The Council has no authority to fundamentally alter controlling law.

#### **4. Section 5006 Includes an Unauthorized Assertion of Regulatory Authority over State and Federal Water Contracting**

**Section 5006:** The Proposed Regulations require “improved transparency in water contracting.” The Council does not have the statutory authority to impose that requirement merely because it is based on a Council determination that water contracting is a “covered action.” While the Delta Reform Act authorizes the Council to review on appeal whether a covered action is consistent with the Delta Plan, it has no role in the initial determination whether a proposed action is a “covered action.” As described above, early language had proposed to give the Counsel a direct role, but the Legislature declined to do so as reflected in the Act. The Council recognizes this at page 54 of the Delta Plan—“The state or local agency . . . determines whether the proposed plan, program or project is a covered action . . .” Nevertheless, Section 5006(b) appears to be an attempt to administratively declare that the Department of Water Resources’ and U.S. Bureau of Reclamation’s administration of their contracts are covered actions. The Legislature, however, has explicitly provided otherwise by excluding routine operations of the SWP and CVP—which includes routine execution and amendment of a water supply contract—in Water Code Section 85057(b)(2). The Delta Reform Act does not authorize the Council to regulate the contract renewal process, and its attempt to do so is inconsistent with the Delta Reform Act.

In addition, any attempt by the Council to alter or amend those contracting policies would be inconsistent with supremacy principles under federal law, which governs the contracting process for water supplied by the Central Valley Project; the Burns-Porter Act (see, e.g., Wat. Code § 12937), which governs the State Water Project; and the Delta Reform Act savings clause (including the provision that nothing in the Act affects the Burns-Porter Act). (Wat. Code, § 85032(e).)

For the foregoing reasons, Section 5006 should be removed from the Proposed Regulations.

**Section 5009:** The Proposed Regulation states that “[s]ignificant impacts to the opportunity to restore habitat at the elevations shown in Appendix 4 must be avoided or mitigated.” It is unclear what constitutes an “opportunity to restore habitat,” and how such an “opportunity” might be the subject of a potentially significant impact (which much be an adverse physical impact under controlling law). (Pub. Resources Code, §§ 21065, 21068; Cal. Code Regs., tit. 14, §§15358, 15382.) These ubiquitous uncertainties violate OAL requirements. Thus, Section 5009 must be removed or revised.

#### **B. Sections of the Proposed Regulations Are Not Necessary or Are Unreasonable**

The OAL will review the Proposed Regulations for compliance with the “necessity” standard. Government Code section 11349(a) defines the necessity standard:

“Necessity” means the record of the rulemaking proceeding demonstrates by substantial evidence the need for a regulation to effectuate the purpose of the statute, court decision, or other provision of law that the regulation implements, interprets, or makes specific, taking into account the totality of the record. For purposes of this standard, evidence includes, but is not limited to, facts, studies, and expert opinion.

To satisfy this standard, Council must provide:

- (1) a statement of the specific purpose of each adoption, amendment, or repeal;  
and
- (2) information explaining why each provision of the adopted regulations is required to carry out the described purpose of the provision. Such information shall include, but is not limited to, facts, studies, or expert opinion. When the explanation is based upon policies, conclusions, speculation, or conjecture, the rulemaking record must include, in addition, supporting facts, studies, expert opinion, or other information. An "expert" within the meaning of this section is a person who possesses special skill or knowledge by reason of study or experience which is relevant to the regulation in question.

Numerous sections of the Proposed Regulations do not meet these legal standards. Examples are set forth below.

**Section 5001:** In the Initial Statement of Reasons, the Council states that the definitions in section 5001 “are necessary to clarify the meaning of terms used in the regulations.” (Initial Statement of Reasons at p.2.) However, at least the following five provisions within the proposed definitions are unnecessary.

**Subsection 5001(k):** The proposed regulatory definition of “feasible” merely repeats the language of Public Resources Code section 21061.1. (See also Cal. Code Regs., tit. 14, § 15364.) As such, the regulation is unnecessary and duplicative.

**Subsection 5001(s):** The proposed regulatory definition of “significant impact” conflicts with existing statutory and regulatory definitions of the same term used in the same context. (Pub. Resources Code, § 21068; Cal. Code Regs., tit. 14, § 15382.) The Council’s proposed regulation is confusing and unnecessary as well as inconsistent with controlling law. (Pub. Resources Code, § 21068; Cal. Code Regs., tit. 14, § 15382; *see also In re Bay-Delta Coordinated Proceedings* (2008) 43 Cal.4th 1143, 1167-1168; *Communities for a Better Environment v. South Coast Air Quality Management District* (2010) 48 Cal.4th 310, 315, 320-322; *Citizens for East Shore Parks v. State Lands Commission* (2011) 202 Cal.App.4th 549, 557-566.)

**Section 5005:** The Initial Statement of Reasons describes section 5005 as necessary to “ensure[] that urban and agricultural water suppliers are taking appropriate actions to contribute to the achievement of reduced reliance on the Delta . . .” (Initial Statement of Reasons at p. 4.) In addition, the text of section 5005 of the Proposed Regulations requires use of water from the Delta watershed to be “significantly reduced.” The Council’s proposed implementation of that requirement violates the Savings Clauses of the Delta Reform Act. (Wat. Code, §§ 85031-85032.) Moreover, the legislative purpose of the Act was to further the coequal goals through the establishment of the Council to improve coordination of state agency actions in the Delta, develop a new Science Program to improve water and ecosystem management in the Delta, and ensure activities of the State and local governments in the

Delta did not preclude progress toward achievement of the coequal goals. These outcomes were to be achieved through the Delta Plan, under which the Council was given the authority to review appeals of consistency certifications for “covered actions.” Regulations seeking to reduce water use statewide and SWP and CVP water deliveries are not necessary for the Council to effectuate these purposes of the Delta Reform Act, which the Legislature directed it to pursue with very limited, rather than expansive, authorities provided in the Act.

**Subsection 5005(c):** Water Code section 85021 calls for a statewide strategy of investment in regional water supply and management actions as a means to help reduce reliance on the Delta in meeting future water supply needs. However, proposed subsection 5005(c) turns this statutory, forward-looking investment policy into a highly punitive threat to current and future water supplies. In doing so, the Council has proposed a regulation that is unnecessary, unreasonable, and inconsistent with the statute itself and that “does not reasonably effectuate the statute.” (Gov. Code, §§ 11342.2, 11346.3, 11349.1(a).)

The Council’s proposed section 5005(c) could prevent water supply entities the use of their water rights, or their contract rights to water service, even if those entities meet all statutory requirements, simply because the Council has decided that another entity has not, in the Council’s opinion, adequately reduced its reliance on water from the Delta watershed. For example, the Council apparently claims the authority (1) to determine that one entity sharing a supply with others (e.g., several retailers served by the same wholesale supplier) has not implemented “all programs and projects” identified in its water management plan as cost effective and technically feasible; and (2) to prohibit the delivery to other parties sharing that supply and for which water management plan compliance has not been questioned. Under this proposed regulation, if “one or more” water suppliers have not satisfied the Council, it claims the right to consider that factor in deciding whether to halt delivery of any of that water to all of the entities sharing that supply. Not only is this assertion of power untenable and not supported by the language of the statute or its legislative history, it also is invalid and ineffective under Government Code section 11342.2.

**Section 5006:** In the Initial Statement of Reasons, the Council asserts that section 5006 is intended to remedy the “lack of accurate, timely, consistent, and transparent information on the management of California’s water supplies and beneficial uses” through “improved public involvement and transparency in decision making processes by enforcing . . . existing contracting policies within the [DWR] and the Bureau of Reclamation.” (Initial Statement of Reasons at p. 5.) However, the requirement in the Proposed Regulation of “improved transparency in water contracting” is redundant of existing policies, as shown in the Council’s own appendices. The specific language merely requires the Department of Water Resources and U.S. Bureau of Reclamation to follow contracting policies that each has developed and is currently utilizing. There is no need for the requirement.

### **C. Sections of the Proposed Regulations Lack Clarity**

The OAL will review the Proposed Regulations to determine whether they comply with the “clarity” standard. (Gov. Code, § 11349.1(a)(3).) “Clarity” as defined by Government Code section

11349(c) means "written or displayed so that the meaning of regulations will be easily understood by those persons directly affected by them." "Clarity" is further defined in California Code of Regulations, title 1, section 16(a):

In examining a regulation for compliance with the "clarity" requirement of Government Code section 11349.1, OAL shall apply the following standards and presumptions:

(a) A regulation shall be presumed not to comply with the "clarity" standard if any of the following conditions exists:

(1) the regulation can, on its face, be reasonably and logically interpreted to have more than one meaning . . . .

Because the Proposed Regulations contain so many vagaries, the regulated community cannot know how they may be required to comply. The Council has an obligation to provide clear and complete regulations for public review and comment such that their requirements are readily apparent. The following examples illustrate where the Proposed Regulations do not satisfy that obligation.

**Subsection 5001(s):** As noted above, the Initial Statement of Reasons states that the definitions in section 5001 "are necessary to clarify the meaning of terms used in the regulations." (Initial Statement of Reasons at p.2.) However, the proposed definition of "significant impact" is confusing. Subsection 5001(s) does not explain what would constitute a "*substantial* impact on the achievement of one or both of the coequal goals," which is a key component of the proposed definition of "significant impact." (Emphasis added.) Thus, in addition to being unnecessary and inconsistent with controlling law, subsection 5001(s) lacks clarity.

**Section 5009:** The Proposed Regulation states that "[s]ignificant impacts to the opportunity to restore habitat at the elevations shown in Appendix 4 must be avoided or mitigated." It is unclear what constitutes an "opportunity to restore habitat," and how such an "opportunity" might be the subject of a potentially significant impact (which much be a physical impact under controlling law). (Pub. Resources Code, §§ 21065, 21068; Cal. Code Regs., tit. 14, §§15358, 15382.) Further, it is unclear how the proposed mandatory language requiring that "opportunity" impacts "must be avoided or mitigated" is to be satisfied.

#### **IV. DEFICIENCIES WITH COST ANALYSIS**

The Cost Analysis of the DSC proposed regulations contains analytical errors, errors of omission, and simply ignores significant costs.

##### **A. The Cost Analysis Does Not Adequately Explain the Assumption of No Cost to Comply with Existing Regulations**

The proposed regulations are based on an apparent assumption that the Proposed Regulations merely duplicate, and do not add to the substantive requirements of existing law, so the costs of the proposed regulations would occur in any case. That assumption is not explicitly stated or supported by

citations to law. Thus, the assumption that particular results of the regulations are already defined in law, and thus generate no costs, is unsupported. To the extent that the Proposed Regulations add substantive mandates, as demonstrated above, the assumption is inaccurate.

**B. The Cost Analysis Greatly Underestimates the Cost of Complying with the Proposed Regulations**

Most simply put, the cost analysis is limited to administrative costs of compliance with the Proposed Regulations; thus, it fails to address the larger direct and indirect economic and social costs associated with application of the regulations as written.

The Proposed Regulations fail to consider:

- Costs (both opportunity and direct costs) due to delays in private projects for consistency determinations;
- Costs due to delays that result in the abandonment of projects;
- Costs due to appeals regarding consistency certifications, and the lack of clear definition of many of the terms of the regulation lend themselves to interminable, hyper-technical legal challenges based on differing interpretations of vague and ambiguous provisions;

Also, the cost analysis ignores the costs associated with the mandatory reductions in the quantity of water conveyed through the Delta, and in reductions in water used from within the Delta watershed set forth in Section 5005 of the Proposed Regulations. The economic and social costs of those reductions are severe. The Public Water Agencies' prior letter regarding the Delta Plan Draft Program Environmental Impact Report, dated February 2, 2012, discusses the work of economists from U.C. Davis and the University of the Pacific, which concluded that in 2009, as a result of a relatively dry hydrology and water supply restrictions imposed on the State Water Project and Central Valley Project, the San Joaquin Valley population lost as many as 7,434 jobs, more than \$278 million in income, and more than \$368 million in overall economic output. (Michael J., et al. 2009. A Retrospective Estimate of the Economic Impacts of Reduced Water Supplies to the San Joaquin Valley in 2009 (Sep. 28, 2010).) Additional support can be found in several court decisions. (*Delta Smelt Consol. Cases* (E.D. Cal. 2010) 717 F.Supp.2d 1021, 1052; *Consol. Salmonid Cases* (E.D. Cal. 2010) 713 F.Supp.2d 1116, 1148; *San Luis & Delta-Mendota Water Authority v. Salazar* (*Delta Smelt Consol. Cases*) (E.D. Cal. 2009) 2009 WL 1575169 at \*5-6.)

To the extent the proposed regulations assume the reductions in the quantity of water conveyed through the Delta would be "offset" by localized actions, the cost analysis does not identify costs associated with those other actions. For example, if the offset is to occur with increased production of groundwater, the cost analysis does not consider the cost of overdrafting groundwater basins.

**C. The Cost Analysis Erroneously Interprets Habitat Restoration as No Cost**

The cost analysis assumes that all habitat restoration will result from the operation of CEQA. There is no basis for this assumption, as nowhere in the Proposed Regulations are habitat restoration goals tied to those required to fulfill CEQA obligations to implement feasible alternatives or mitigation measures to address significant environmental impacts. As a result, the cost analysis improperly assumes no cost for habitat restoration that may be required as a result of the Proposed Regulations.

Further, the related requirement to protect opportunities to restore habitat imposes additional opportunity and direct costs, as use of private property may be affected by restoration effort mandates. The discussion in the cost analysis focuses on areas that are currently regulated to justify its finding of no additional costs, but fails to examine the costs associated with those areas which are not currently regulated.

**D. The Cost Analysis Ignores Potential Costs Associated with Implementing the Requirements to Reduce Reliance on Delta Watershed Water to Meet Future Water Supply Needs**

While existing law may require regions to improve water conservation, groundwater management, and multiple other water use changes (see Wat. Code, § 10608 et seq.), Section 5005 of the Proposed Regulations threatens loss of water supply for failing to meet certain reductions in water used from the Delta watershed. The Proposed Regulations state, if a region fails to “adequately contribute,” to water use reductions,<sup>10</sup> those within that region may not receive water from within the Delta, or conveyed through the Delta. If restrictions on water supply are imposed pursuant to Section 5005, such draconian consequences will drive significant expenditures beyond what is currently underway. Conversely, those regions which have already significantly complied with the requirements may have limited ability to further reduce their demand. Those regions may lose opportunities to have sufficient water to meet demands or be forced to spend large sums of money on projects that are not otherwise cost-effective. Thus, the Council has yet to analyze the economic costs associated with the implementation of Section 5005.

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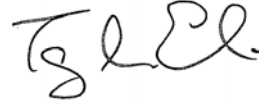
<sup>10</sup> “Adequately contribute” is undefined. Thus, the cost of compliance may be unknowable. However, the Council cannot promulgate an unlawfully vague and ambiguous regulation, then use the vagueness and ambiguity as an excuse not to conduct the required economic analysis of the impact of implementing the Proposed Regulations.

For all the reasons stated above, the Proposed Regulations including the Cost Analysis are fundamentally flawed and should be revised and recirculated for public comment.

Sincerely,



Daniel G. Nelson  
Executive Director  
San Luis & Delta-Mendota Water Authority



Terry L. Erlewine  
General Manager  
State Water Contractors

## ATTACHMENT 1

The State Water Contractors (SWC) represents 27 public agencies that contract with the State of California for water from the State Water Project (SWP). These agencies are each organized under California law and provide water supplies to nearly 25 million Californians and 750,000 acres of prime farmland from Napa County to San Diego and points between.

The San Luis & Delta-Mendota Water Authority (SLDMWA), which was formed in 1992 as a joint powers authority, consists of 29 member agencies, 27 of which contract with the United States Department of the Interior, Bureau of Reclamation (Reclamation), for supply of water from the federal Central Valley Project (CVP). SLDMWA's member agencies hold contracts with Reclamation for the delivery of approximately 3.3 million acre-feet of CVP water. CVP water provided to SLDMWA's member agencies supports approximately 1.2 million acres of agricultural land, as well as more than 100,000 acres of managed wetlands, private and public, in California's Central Valley. SLDMWA's member agencies also use CVP water to serve more than 1 million people in the Silicon Valley and the Central Valley.

SLDMWA Member Agencies:	SWC Member Agencies:
Banta-Carbona Irrigation District	Alameda County Flood Control and Water Conservation District Zone 7
Broadview Water District	Alameda County Water District
Byron Bethany Irrigation District (CVPSA)	Antelope Valley-East Kern Water Agency
Central California Irrigation District	Casitas Municipal Water District
City of Tracy	Castaic Lake Water Agency
Del Puerto Water District	Central Coast Water Authority
Eagle Field Water District	City of Yuba City
Firebaugh Canal Water District	Coachella Valley Water District
Fresno Slough Water District	County of Kings
Grassland Water District	Crestline-Lake Arrowhead Water Agency
Henry Miller Reclamation District #2131	Desert Water Agency
James Irrigation District	Dudley Ridge Water District
Laguna Water District	Empire-West Side Irrigation District
Mercey Springs Water District	Kern County Water Agency
Oro Loma Water District	Littlerock Creek Irrigation District
Pacheco Water District	Metropolitan Water District of Southern California
Pajaro Valley Water Management Agency	Mojave Water Agency
Panoche Water District	Napa County Flood Control and Water Conservation District
Patterson Irrigation District	Oak Flat Water District
Pleasant Valley Water District	Palmdale Water District
Reclamation District 1606	San Bernardino Valley Municipal Water District
San Benito County Water District	San Gabriel Valley Municipal Water District
San Luis Water District	San Geronio Pass Water Agency
Santa Clara Valley Water District	San Luis Obispo County Flood Control and Water Conservation District
Tranquility Irrigation District	Santa Clara Valley Water District
Turner Island Water District	Solano County Water Agency
West Side Irrigation District	Tulare Lake Basin Water Storage District
West Stanislaus Irrigation District	
Westlands Water District	

## **EXHIBIT 4**



**FEMA**

**OCT 23 2012**



Mr. Mark Ghilarducci  
Governor's Authorized Representative  
California Emergency Management Agency  
3650 Schriever Avenue  
Mather, California 95655

Reference: Termination of the Memorandum of Understanding between the State of California Emergency Management Agency and the Federal Emergency Management Agency regarding the Sacramento San Joaquin Delta  
Cal EMA Log 460876; FEMA Log 306486.1

Dear Mr. Ghilarducci:

This letter constitutes written notification of the need for the Federal Emergency Management Agency (FEMA) to terminate the Memorandum of Understanding Regarding Criteria for Public Assistance Eligibility for Reclamation Districts in the Sacramento/San Joaquin Legal Delta (MOU). See MOU Section XI (February 25, 2010).

FEMA has determined that the MOU as currently drafted is vague and fails to adequately address both current levee standards and FEMA Public Assistance Policy. For these reasons – and as a result of recent communications with the California Emergency Management Agency (CalEMA), the California Department of Water Resources, and other effected parties – we have determined that terminating the MOU at this time is the best course of action. The effective date of termination of the MOU is forty-five (45) days from today's date, which is December 8, 2012..  
*Id.*

Although the rainy season is quickly approaching, FEMA's Public Assistance staff have already begun work with your staff to determine the best standards and terminology for a new agreement. We look forward to working through these issues in the coming months and finalizing a new MOU.

*Mr. Mark Ghilarducci*  
*Termination of M.O.U.*  
*Page 2 of 2*

If you have any questions regarding this matter, please contact me at (510) 627-7100 or Terrie Zuiderhoek, Director of our Recovery Division, at (510) 627-7250.

Sincerely,



Nancy Ward  
Regional Administrator  
FEMA Region IX